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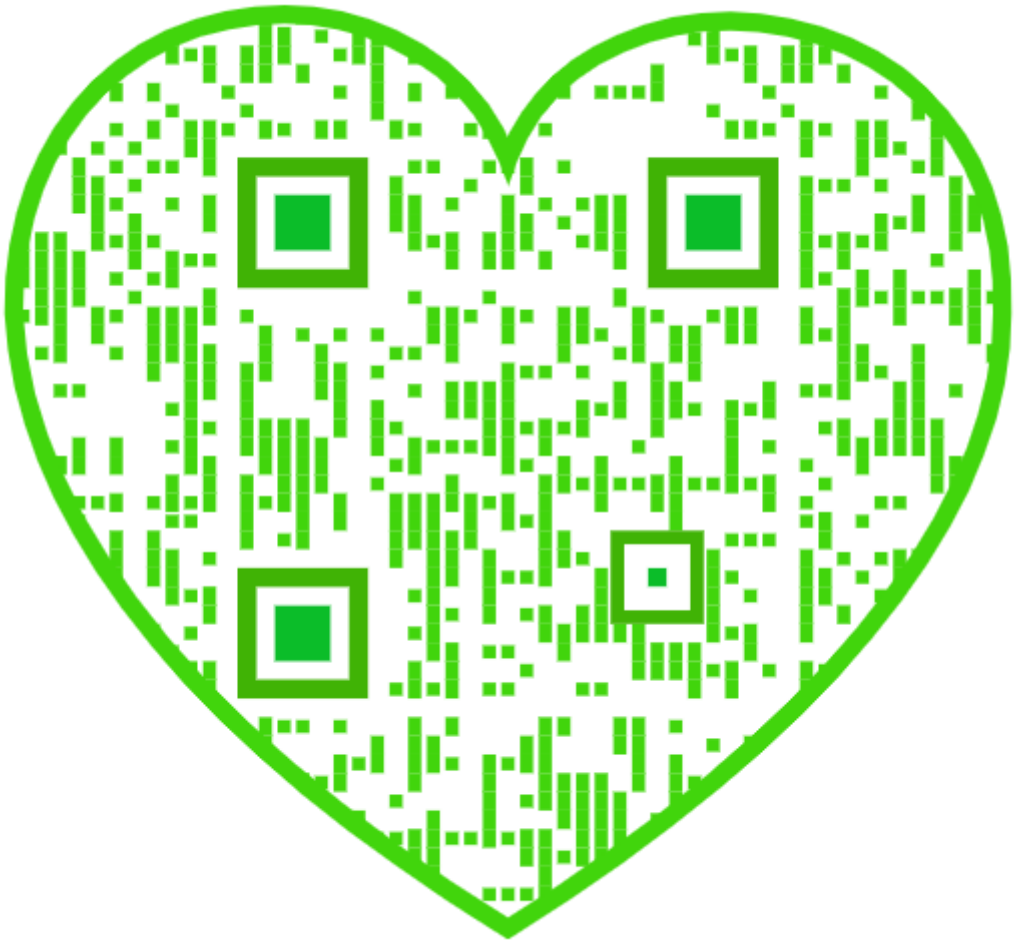

MUNICIPAL ENGINEERING

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JULY — DECEMBER, 1914

Jan - March. 1915 in back of book

VOLUME XLVII

136453
1916
15

ENGINEERING PUBLISHING COMPANY
INDIANAPOLIS, IND.
NEW YORK, N. Y. CHICAGO, ILL.

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MUNICIPAL ENGINEERING

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MUNICIPAL ENGINEERING

The World's Leading Municipal Publication.

GARBAGE DISPOSAL PLANT AT MONTCLAIR, N. J.

VOL. XLVII. JULY, 1914. NO. 1.

Whoso would be a man must be a nonconformist. He who would gather immortal palms must not be hindered by the name of goodness, but must explore if it be goodness. Nothing is at last sacred but the integrity of our own mind. Absolve you to yourself and you shall have the suffrage of the world.—EMERSON.

Published by

Engineering Publishing Co.
INDIANAPOLIS, IND.

New York Office:
1125 World Bldg.
GEO. H. CLINGAN,
Eastern Mgr.

Chicago Office:
438 Marquette Bldg.
E. D. POWELL, Western Mgr.

Entered at Postoffice, Indianapolis,
as Second-Class Matter.

A. P. Fox, President. **C. C. Brown, Editor.** **C. S. Sale, Gen'l Mgr.**

Subscription Price in U. S. and Possessions, Cuba and Mexico, $2.00. Canada, $2.40. Foreign, $2.75.

Changes of address, subscriptions, remittances and editorial matter
should be addressed to MUNICIPAL ENGINEERING, Indianapolis, Ind.

THE BITULITHIC PAVEMENT

By Don Montell Forester, Georgia School of Technology.

One of the clearest and fullest statements of the qualities peculiar to bitulithic pavement, the decisions regarding the patented features of its construction, and the methods of securing the results aimed at by the inventor, Fred J. Warren, which has been made, is to be found in a thesis submitted for the degree of Bachelor of Science in Civil Engineering, from which these extracts are taken, lack of space being the only reason for omitting any part of the production. The earlier portions of the thesis are briefly indicated in abstract, and the latter portion, excluding specifications, is given practically in full.

EARLY road construction of a permanent nature was of the massive type built by the Romans.

Modern road building began with the military roads of Napoleon I. The macadam and telford types were developed in England early in the nineteenth century and are fully described in the thesis. Their life is short under modern traffic conditions and other materials and methods of construction have been devised to increase the economy of road maintenance. The difficulty is to give a life to the road proportional to the increase in first cost. The importance of the invention of the stone crusher and the steam roller is recognized.

The qualities needed in a pavement include (1) good wearing quality, (2) good footing for horses, (3) non-slipperiness, (4) noiselessness, (5) easy drainage, (6) a surface easily cleaned, (7) low cost. The most important problem is to secure the first six qualities at the minimum cost. The new motor traffic makes the problem still more difficult and adds to the demand for a satisfactory wearing surface.

All authorities admit the passing of macadam as a satisfactory pavement for heavily traveled roads.

Asphalt and brick are compared with the ideal and the defects in design and construction are stated in detail in the thesis.

Many experiments have been made to produce a surface that would wear, possess an ability to resist the raveling effects of fast-moving motor cars and still be within a reasonable cost limit. The large amount of macadam in existence was the chief reason the engineers attempted to find protection to the existing surface rather than an entirely new form of construction.

These investigations brought forth two classes of pavements; one where the macadam was treated with different kinds of tar preparations in an endeavor to bind it firmly together and prevent dust. Some of these bituminous macadams have proved quite successful and as they are relatively inexpensive, will more than probably come into popular use where an inexpensive pavement with reasonable wear is needed and a higher priced construction is not warranted. The other class of pavement evolved was one that takes the place of asphalt on city streets and does not possess defects found in he other types, being economical in cost as well as in wear. Of this type of pavement one in particular will be treated which is the subject of this article—namely, "Bitulithic," a patented bituminous pavement.

The influence of the seven Warren brothers on asphalt and bituminous pavement development is shown and especially of Fred J. Warren. He conceived the idea that a roadway wearing surface, superior to anything then devised, could be made of a mixture of bituminous materials and crushed stone, varying in size from a maximum which may be as large as 1½ inches to 2 inches, depending on the pro-

Views of streets in Atlanta, Georgia, paved with Bitulithic, under construction and completed, followed by photographs of parts and the whole of the paving plant used by the Southern Bitulithic Company in the Atlanta work.

Peachtree street, looking south toward Peachtree Place. Foundation of eight inches of stone, rolled to grade and covered with asphaltic cement.

Peachtree street, looking south from Tenth street. Stone base being rolled to grade before coating with asphaltic cement.

posed depth of the wearing surface, down to a minimum size of impalpable powder, the varying sizes being carefully and accurately proportioned so that each succeeding size of particles of aggregate would be in such proportion as to fill the spaces between the coarser particles and so on down to the finest powder, thus producing a compact structure of crushed stone which, irrespective of the bituminous material, would have a high degree of inherent stability and the lowest practicable percentage of voids.

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¶ INHERENT STABILITY *of the broken stone by reducing the voids and consequently the proportion of bitumen to a minimum was Fred J. Warren's basic principle.*

Mr. Warren's idea was to produce a pavement that would:

First—Have a greater durability than asphalt;

Second—Provide a foothold for horses equal to the macadam and, at the same time, maintain a relative or general smoothness of an asphalt pavement;

Third—Overcome the necessary muddy or dusty condition of macadam and provide a pavement that, while having a density of solid stone, would at the same time have great elasticity.

With these basic ideas it took nearly two years' close laboratory study and thought to work out the details, including the devising of the necessary plant, before he was ready to present to the public the new construction, founded on principles so simple that no one had ever before thought of applying them to the building of pavements. The new pavement was patented and was subsequently christened "bitulithic," derived from the Latin word "bitumen" and the Greek word "lithos" meaning stone, the pavement being made of a combination of bitumen and stone.

The vital points wherein the bitulithic surface differs from the ordinary macadam and sheet asphalt are well brought out in "Warren Brothers Company vs. City of Owosso, No. 1828, in the United States Circuit Court of Appeals, Sixth Circuit," from which the thesis makes copious extracts, not necessary to reproduce here, as they have been published in earlier numbers of MUNICIPAL ENGINEERING.

The conclusion shows that the court decisions have supported the validity of the patents by full and accurate courses of reasoning on the complete statements of facts presented in the cases.

George W. Tillson's description of the pavement in a paper before the Franklin Institute is as follows:

"Bitulithic pavement is made of crushed rock and bitumen, the particles of stone being mixed in certain scientifically predetermined proportions as to sizes so as to provide a maximum of density and a minimum of voids, so that the resulting bituminous concrete is nearly as dense as a block of solid stone with a surface that offers as little resistance to traction as asphalt, but one that is not slippery, because the fine stone used in the finishing course provides a gritty surface, similar to macadam, which affords secure footing for horses at all seasons."

In November, 1907, at the meeting of the Massachusetts Highway Association to discuss suppression of dust, Franklin C. Pillsbury, expressing the opinion of the Massachusetts Highway Commission, of which he was a division engineer, said:

"The bitulithic pavement is undoubtedly the best form of pavement to give the desired results (durability and freedom from dust under fast motor-car travel), but it is too expensive for many locations."

A practical expression of opinion was given by the Chicago South Park Commission, which selected it for use on several miles of boulevards, 50 feet wide, after two weeks of investigation and after competitive bids for others forms of pavements.

Bitulithic pavement has now been in use about thirteen years and it has increased from having been laid in seven cities amounting to 16,400 square yards the first year to 129 cities using 5,081,068 square yards in 1913. The following table

Peachtree street, looking toward Eighth street. Bitulithic surface after rolling to grade and before placing flush coating of asphaltic cement and fine stone.

Peachtree street, looking toward Peachtree Place. Top course of bitulithic surface being placed; taken before rolling.

Peachtree street, looking south from Eighth street. Finished street, after placing flush coating of asphaltic cement and fine stone, and rolling. View taken two hours after work was finished.

shows this increase, the amount laid each year and the number of cities:

1901....	7 cities	16,400 square yards
1902....	33 cities	400,831 square yards
1903....	40 cities	915,630 square yards
1904....	45 cities	1,041,724 square yards
1905....	42 cities	1,041,327 square yards
1906....	57 cities	1,508,095 square yards
1907....	66 cities	1,924,222 square yards
1908....	62 cities	1,676,433 square yards
1909....	74 cities	2,071,987 square yards
1910....	97 cities	3,047,276 square yards
1911....	99 cities	4,189,182 square yards
1912....150 cities		4,830,601 square yards
1913....129 cities		5,081,068 square yards
1914....	81 cities	*4,112,667 square yards

*Laid and under contract May 31, 1914.

1808 miles roadway, 30 feet wide between curbs....31,857,443 square yards

Bitulithic had been adopted in 312 cities up to May 31, 1914, as a standard pavement. These cities range from Washington, Oregon and California to New York, New Jersey, Massachusetts and North Carolina; from Ontario, Manitoba, Idaho and Alberta to Texas, Georgia, Alabama, Louisiana and Arizona. Its use has become widespread and from every quarter the verdict appears to be in favor of bitulithic. It is true that in some instances it has been reported that the pavement was not successful, but these cases are so rare that it would seem as if the fault lay elsewhere than with the pavement itself. Regarding the durability we find that bitulithic in Newark, N. J., Yonkers, N. Y., Boston, Mass., Pawtucket, R. I., and Springfield, Mass., has been laid from ten to twelve years and with little repairs in that time. On Harvey street, Pawtucket, R. I., bitulithic was laid in 1901 with an 8 to 12 per cent. grade; 960 square yards were used and repairs have been unnecessary since that time and furthermore it is worth noting that the scouring effect of the rain water along the gutters has not been near so great as is usually the case where sheet asphalt is used.

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¶ THE METHOD OF CONSTRUCTION *has been very carefully worked out on the lines here described.*

The specifications for the foundation of the pavement should be made after a careful consideration of the character of the sub-soil or material over which the pavement is to be laid.

If the sub-soil is such that it can be rolled firm with a heavy roller, a bituminous base is recommended. After the sub-soil is rolled very thoroly it is laid to a depth of 4 to 6 inches or possibly more of broken stone or slag, the pieces varying from 2 inches to 3 inches in diameter; the depth and size varying according to the character of the sub-soil and the traffic to which the pavement will be subjected. This foundation is thoroly rolled with a heavy steam roller. Upon the surface of the foundation stone is spread a heavy coating of specially prepared bituminous cement which fills the crevices between the stone and makes the mass waterproof.

If the sub-soil is spongy clay or other material which cannot be rolled to provide a solid foundation, a hydraulic concrete foundation is not only advisable but necessary. This foundation is mixed and laid in the ordinary way 4 or 5 inches in thickness, depending on the strength of the sub-foundation. In order to present a good bonding surface for the bitulithic work it is very important to roughen the surface of the concrete after it is thoroly tamped but before the mortar has become set. This is done by tamping into the surface rough stone fragments. Before laying the bitulithic surface the concrete is carefully swept.

Where the street to be improved is now paved with macadam or other form of pavement, such as stone blocks, cobbles, or brick on either concrete or other form of foundation, and the condition of the street is such as to permit raising the grade about 3 inches, bitulithic may be successfully used. It is necessary to clean and roughen the existing surface thoroly in order that the bitulithic surface may bond well.

Upon the foundation or base which has been prepared is spread the wearing surface which is compressed with a heavy road roller to the desired thickness, usually about 2 inches. The surface mixture is made of the best stone obtainable, varying in size from a maximum of 1 inch or 1½ inches down to an impalpable powder; the maximum size of stone used in all cases equal to one-half the thickness of

Lee street, looking north from Gordon street. This pavement has been down ten years.

Park street, looking west from Hammond street, in use ten years. Bad condition along car track is due to settling of the track.

Ponce de Leon avenue, looking west from St. Charles avenue. This pavement has been in use four years.

the wearing surface, the various sizes of smaller stone, sand and an impalpable powder being provided to fill the spaces between the larger stones. The proportions used of the various sizes of mineral are pre-determined by physical tests with a view of obtaining the smallest percentage of air spaces or voids in the mineral mixture, and vary with the character and shape of particles of the stone used in each particular case. After the proportions have been determined, the mineral matter is passed thru a rotary dryer from which it is carried up an elevator and thru a rotary screen which separates the mineral into several groups of sizes. The proper proportion by weight of each of these sizes is secured by the use of a scale having seven beams, the exact amount being weighed out and run into a double-shaft rotary mixer. The stone is heated to such a degree in the dryer that it will be at a temperature of about 260° F. when run into the mixer. These proportions of mineral matter are so determined that their combination will have about ten per cent voids. While the stone is in the mixer it is combined with a sufficient quantity, which is accurately determined, of heated bituminous cement to coat all of the stone particles, fill the voids and leave a small surplus. The whole is then thoroly mixed together and dumped while hot into carts or wagons and hauled to the street and spread and thoroly rolled with steam rollers. When placed the mixture should be at a temperature of about 180° F. to 200° F. Heavy rollers, from twelve to twenty tons, are found to be much more efficient than the ordinary rollers. The effect of the rolling is to compress the material to the desired thickness and to make the surface as dense as possible.

After the surface is thoroly rolled a flush coat of quick-drying bituminous cement is applied to the surface, thoroly sealing it and increasing its water-proofness. This coating leaves the surface sticky and into this sticky layer is applied a thin layer of fine crushed stone, varying from ¼ to ¾ of an inch in size, according to the roughness desired. The pavement is then again thoroly rolled. This leaves a final surface that is gritty and well calculated to give purchase for horses' hoofs. The final layers vary with the grade, the greater the slope the larger the stone used. After this final rolling the street may be opened to traffic as soon as the surface has cooled to the temperature of the air.

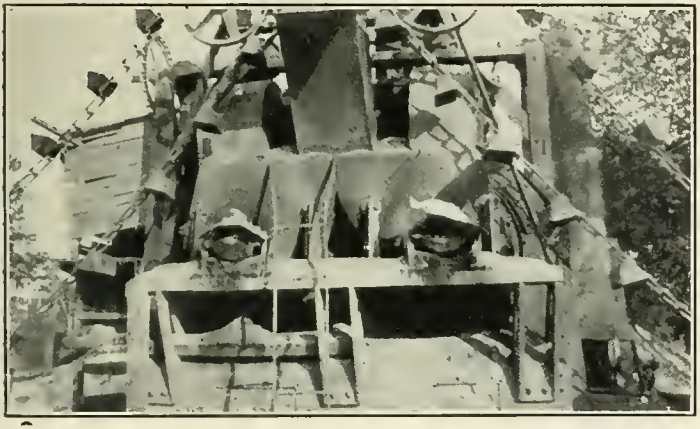
On streets where car rails are laid, a slightly different form of construction has been found necessary. It has always been found difficult to prevent bituminous surfaces from crumbling or cracking adjacent to the rails, owing to the continual slight movement of the rails and ties under the pressure of passing cars. In bitulithic work this difficulty has been obviated by placing a double row of paving block of stone, wood or brick on each side of each rail. The blocks are laid in a cement foundation and well cemented together. The result has been almost a total freedom from the hollows often seen along the car tracks in sheet asphalt and tar macadam work.

On flat grades a crowned surface is usually adopted, the slope being ¼ inch for each foot of width exclusive of street car tracks. A slightly less crown is used for steeper grades.

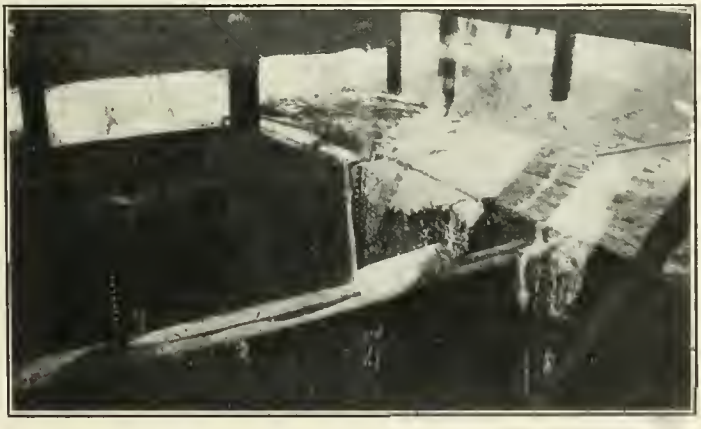
¶ ELABORATE EQUIPMENT *of laboratories, special machinery and materials, and expert direction, do not limit the construction to permanent plants, but permit the use of smaller portable and semi-portable paving plants.*

The elaborate outfit of laboratory and machinery and skilled direction required to produce this pavement successfully would seem at first to limit construction to the vicinity of permanent plants, or to sufficiently large quantities of work to warrant the heavy expense for freight charges and installation of semi-portable plants, and these ideas are strengthened by visiting such plants and examining the work in progress. There have, however, been built and patented by the Warren Brothers Company a number of one-car portable bitulithic railroad paving plants, each permanently set upon a platform car so that it may be easily transported over the railroad lines from place to place. These cars are hauled to the cities

General view of bitulithic paving plant, with dryers in the foreground.



View of dryers at intake end.



Top of ogee-bottomed bitumen tanks.

in which it is desired to construct the pavement and are left in some out-of-the-way corner of the yards. The apparatus is then set up on the car and the material prepared, after which it is hauled to the place of operation and spread. These outfits make it possible to build this pavement in many widely distant places and to give to all of them equally reliable results.

The principal parts of the portable plant are:

Boiler and engine.

Rotary dryers for drying and heating the stone.

Elevators for conveying the stone to the desired places in the plant.

Sectional screens for separating the stone into the several sizes.

Sectional bins for storing the different sized stone.

Weighing box resting on a seven-beam scale.

Twin pug mechanical mixer.

Ogee-bottomed bitumen melting tanks.

Bitumen weigh-bucket and dial-scale.

Rotary exhaust fan.

Dust separator for reclaiming dust drawn by the exhaust fan from the stone while it is drying.

Steel platform car.

The permanent plants are about the same, the only difference being the size and arrangement. In addition to the parts named above there are a number of minor appliances. The portable railroad plants are patented and Warren Brothers Company also hold patents for numerous other mechanical contrivances used in the construction of bitulithic pavement. Among these is a machine for spreading the final coat of quick-drying cement and a stone sprinkling machine for spreading the final layer of heated stone chips.

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¶ PRICES VARY *according to cost of labor and materials on the ground and amount of work to be done. Quality is shown by frequent laboratory tests during construction, and proved by satisfaction under traffic.*

The prices of bitulithic pavement vary within wide limits in different localities, owing to variations in the costs of labor and materials, area of work to be done, proximity of the work to railroad sidings and other conditions. The average price in 1912, in some 225 cities, was $2.35 per square yard, ranging from about $1.90 to $2.90. This does not include grading but does include a five-year guaranty.

A sample of the bitulithic pavement taken from the south side of McLandon street, Atlanta, Georgia in March, 1913, while it was being laid and tested showed the following, test being made in the laboratories of Warren Brothers Company:

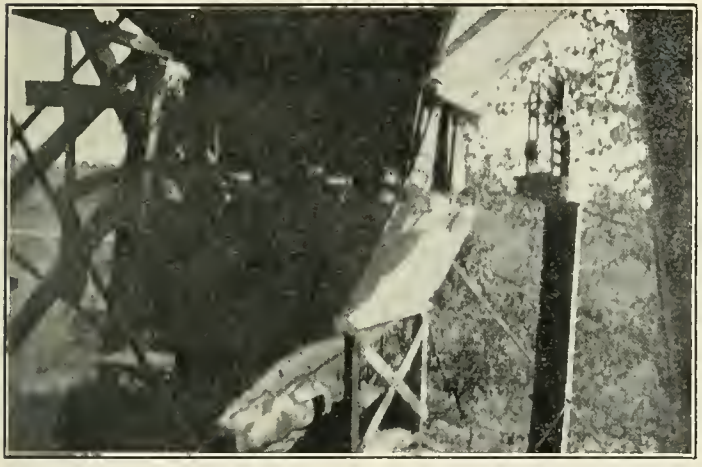
Bituminous cement, per cent. found.. ..... 7.8 per cent.

Equal to standard.

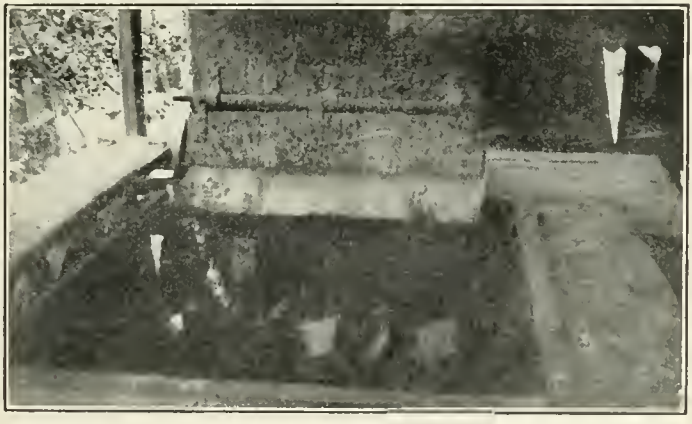
Mineral extraction after extraction of bitumen—exclusive of bitumen:

Passing screen.	Per cent.
1 1/2-inch	25.1
1 -inch	7.2
3/4-inch	13.6
1/2-inch	17.
1/4-inch	4.2
1/10-inch	22.1
1/80-inch	1.4
1/100-inch	4.7
1/200-inch	4.7
Total	100.0

Ogee-bottomed melting tanks, end view.



Weighing pan for stone. Scale beam on the right.



Twin pug mixer, showing paddles or blades and the carrier and weighing tank for melted bitumen.

BACILLUS COLI IN WATER SUPPLY

ITS SIGNIFICANCE AND IMPORTANCE

By Joseph Race, F, I. C., City Bacteriologist, Ottawa, Ont.

The presence of bacillus coli in a sample of water is not certain evidence that it is dangerously polluted and contains disease-producing germs, but it is a definite warning, not to be ignored with safety, that the water is polluted and the source of that pollution must be determined and kept under close observation at all times, to insure that it does not become dangerous. Mr. Race, in this paper, for which we are indebted to The Canadian Engineer, emphasizes these statements and gives warning against the present tendency to minimize the value of the indication given by the presence of that organism.

WHILE too much importance has been attached in the past to the presence of b. coli in water used for domestic supplies, it is regrettable that the pendulum is now showing a tendency to swing too far in the opposite direction. The paper of Geo. A. Johnson (Pro. Amer. Waterworks Assoc. 1913, pp. 399-455), of Johnson & Fuller, New York, is an illustration of this movement. The all too common practice of using arbitrary and empirical methods in the bacteriological examination of water is partially responsible for the present status res, and in this regard bacteriologists have only themselves to blame. As will be shown later, the mere presence or absence of b. coli in an arbitrarily fixed amount of water may have no significance when considered without regard to other circumstances; and in attempting this we are merely opening the way for criticism. The Committee on Standards of the American Public Health Association (1912) evidently recognized the futility of such procedure when they recommended that quantitative estimations should be made of b. coli. They add: "Qualitative results, when viewed superficially, may seem easier to obtain than, and quite as conclusive as, quantitative results; but detailed evidence shows that in general the quantitative tests are by far the most fruitful source of information." It would appear that the committee might have gone further and deprecated the use of qualitative tests except under extraordinary circumstances. This procedure has also had a deleterious effect on those connected with sanitary work, and who, by reason of their lack of familiarity with the technique employed have accepted this sophism. The author believes that, even with all the assistance that quantitative methods of examination afford, it is often difficult to give a sound opinion on the hygienic quality of a water supply, and that it would be folly to revert to the older methods.

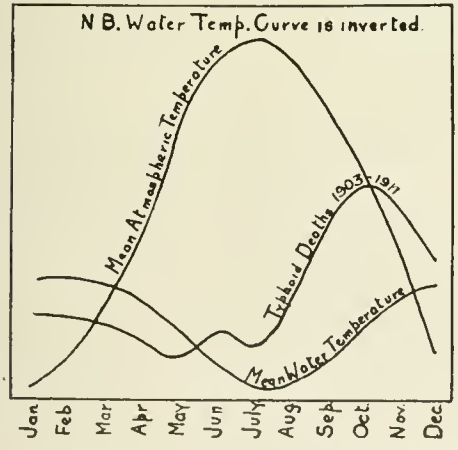
There are many points of difficulty surrounding the significance of b. coli, and on several of these the present knowledge is very meagre. Almost everyone is aware that b. coli is common to the excreta of nearly all the higher and lower animals. In cold-blooded animals the occurence is less constant, and more or less discordant results have been obtained. Dr. Amyot (Trans. Am. Pub. Health Assoc., 1901), concluded that b. coli is not normal in the intestines of fish, and that when present is due to the polluted environment. The tendency among animals generally is for b. coli to become rarer as the zoological type becomes lower. None of the lower types, however, are susceptible to typhoid fever, man being alone in this respect, so that there is a possibility of having b. coli un-

accompanied by b. typhosus. This b. coli has, therefore, no significance.

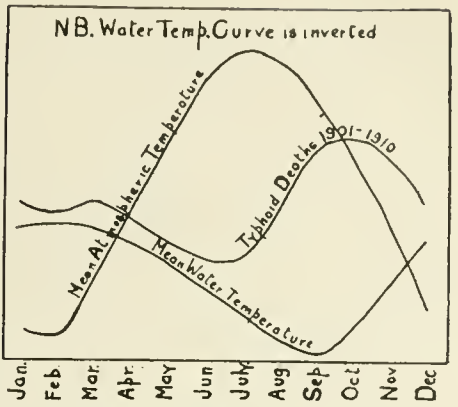
In reference to the b. coli present in a water supply and due to human sources, it is important that information should be obtained regarding the total population on the watershed, the prevalence of typhoid and the probable period elapsing before the diluted sewage reaches the water services of the town under consideration.

The population is comparatively easy to obtain, and the typhoid death rate can, in most cases, be calculated from past records. In addition to the mortality, however, the case incidence should also be considered, as this has an important bearing on the probable ratio of b. coli to b. typhosus by its influence on the number of carriers. In Great Britain and certain portions of Europe the incidence is much lower and the case mortality higher than on this continent, so that the ratio of b. coli to b. typhosus is entirely different. It is possible that this ratio is ten times greater in North America than in Europe, and much greater significance ought, therefore, to be attached to b. coli here.

The period elapsing between the discharge of the sewage and the withdrawal



TYPHOID DEATHS *in Ottawa. Average each month for years* 1903 *to* 1911, *compared with the mean atmospheric and water temperatures. The curve of water temperatures is inverted to show more clearly the parallelism of the curves, cold water corresponding to longer life of b. typhosus in the water.*



TYPHOID DEATHS *in Toronto. Average each month for years* 1901 *to* 1910, *compared with mean atmospheric and water temperatures, the latter curve being again inverted.*

of the water is the most important factor, and in this connection the temperature of the water must be considered. Typhoid bacilli, in the absence of suitable food material, find an unsuitable environment in water, and, the cell energy being entirely of a katabolic nature, they die rapidly. It is obvious that this increases with the period of storage, and a consideration of the mechanism of the process also leads to the conclusion that the katabolic wasting increases with rise in temperature and vice versa. Dr. Houston and others have supported this hypothesis, by numerous and conclusive experiments. It is important, therefore, that the bacterial contamination should be considered in its relation to the water temperature, and this leads to the conclusion that b. coli should be regarded as having greater significance in winter than in summer. In the diagrams illustrating this point the temperature curve has been inverted so as to conform with the viability of typhoid in water. In both the Ottawa and Toronto diagrams the typhoid death curve and the inverted water curve show a noticeable parallelism in the winter months, and as it is during these months that outside cases are at a minimum, the typhoid incidence is probably water-borne. The plotted figures for Toronto before and

TYPHOID DEATHS *in Toronto. The full line shows the average number each month in the years* 1903 *to* 1911, *before filtration was begun. The dotted line shows the averages in* 1912 *and* 1913, *after the filtration of the water was begun. Note the reduction in typhoid in the colder months. The high summer rate is attributed to imported cases, which filtration of the water would not affect.*

after the operation of the filtration plant show that it is this winter rate that has been reduced, whilst the summer prevalence, mostly due to imported cases, has remained unaffected. In Ottawa, with efficient sterilization with hypochlorite, only one case of typhoid has been reported for the first four months of the present year. These results show what can be accomplished by water purification, and also that the significance of b. coli must not be considered in an arbitrary manner.

Attempts have been made to belittle the value of the b. coli test because the b. coli content of the water supplies of certain cities did not bear a constant relation to the typhoid death rate. In such statements the sources of the typhoid incidence are not stated, and this, in many cases, may lead to erroneous conclusions. From the above remarks it is not to be expected that even typhoid rates due to water will closely correspond with the b. coli content; all that can reasonably be anticipated is an approximate agreement. Cities with high b. coli contents will tend, *caeteris paribus*, to high typhoid rates and the removal of b. coli to decreasing rates. Let everyone remember that the b. coli test is not a positive test for the presence or absence of pathogenic organisms, but an inferential test of danger and of potential injury to public health.

HOUSTON'S PAVING PROGRESS

The great paving movement now under way in Houston, Tex., is one that entitles both the municipal administration and the citizens who are co-operating to unusual credit, because it is preparing the city for the best growth it has ever enjoyed. One can never know just how much the mud lanes have retarded Houston's growth, but all will learn within five years how paved streets contribute to the general progress. The value of the present paving program is far greater than the pavements actually being constructed, because of the sentiment for good streets that is being created in every section of the city.

Another important feature of the paving program is the fact that in all cases the paving is preceded by sewerage and drainage, which are to insure for the future not only good streets, but ideal living conditions and good sanitation. The pavements are being put down to remain—not to be torn up and destroyed every time it becomes necessary to make sewerage or water connections.

Mayor Campbell, the commissioners and the citizens who are co-operating deserve the commendation of all the people for the splendid progress that is being made in lifting the city out of the mud. The financial sacrifices that have been made and that are being made are well worth while.

THE CITY MANAGER

THE LATEST PLAN FOR MUNICIPAL MANAGEMENT

By Paul E. Kressly, C. E., City Engineer, Inglewood, Cal.

After a brief experience of the plan in operation, the city manager in one of the latest of the small cities to adopt this new plan for managing the daily affairs of cities describes briefly the development of the idea and states the improvements which it is expected will result. The advantage to the small city in having all its activities under the control of a single expert always on the job, instead of under many elected officials, who can spend only the odds and ends of their time in the city's business, should be evident very shortly, especially since he should be able to save enough money so that the city can afford to employ the most experienced and competent man available.

THE city manager, the latest innovation in the government of American municipalities, is a result of the Galveston hurricane. When, fourteen years ago, wind and wave conspired to wreck the Texas island city, the conditions created by the catastrophe demanded so much progressive and constructive work of the city government that the old system of a board of aldermen and independent elective officers broke down. A group of business men petitioned the state government to suspend the local government and replace it temporarily with a commission of five men on a strictly business basis. The commission in a few days accomplished what a city council would have required months to do. Des Moines, the Iowa capital, improved the idea, and from that beginning the commission form of government has spread with surprising rapidity thru the United States, and a peaceful revolution in over three hundred cities has swept away the boards of aldermen, mayors and a host of minor officials and set up new municipal governments on a plan so simple that the services of the "political boss" are not required to direct them.

While this form of government is a vast improvement over the form in general use up to seven or eight years ago, there is unquestionably room for still more improvement. In some cities it has proved very successful, while in others it has been a complete failure. In some cities the weaknesses of commission government are beginning to appear in a very striking way.

For example, in Wichita, Kan., the commission has authorized the issue of $88,000 in five-year bonds to cover current deficiencies. After four years of the new rule, that does not look like good business. Certain things in the local situation are directly or indirectly responsible for this condition. One of the members of the commission is an ex-street laborer, an honest calling, but one scarcely giving a man the preparation for managing one of the departments of a city as important as Wichita. A reputation for integrity and honesty cannot insure a good business manager.

It is only by accident that you can secure five men who will be at the same time perfect representatives of recognized divisions of the people and at the same time properly equipped for administrative service. Each commissioner naturally wishes to make a record for himself in his departmental work, so he pulls for a larger slice of appropriations in the council, and when all five commissioners do the same thing the annual budget must be stretched accordingly. Therefore, when the commission is not composed of the proper men, who will work together, the government can in fact be resolved into five separate governments.

The great thing the commission form of government has done, is to demonstrate

the wisdom of giving over to a single elective governing body all the municipal powers. It has given the people a workable instruemnt, so far as general regulation is concerned, but it has failed to give the governing body the means with which to translate the geenral will of the people into detailed acts of government iu the most effective way. A five-headed government carries with it the possibilities of friction, which leads to inefficiency, which in turn, leads to waste and even corruption. Furthermore, we cannot secure municipal experts by the process of popular election.

We must build upon the solid foundation of popular control, which commission government has laid, the structure of a strong and well-conceived administrative organization. We must separate the functions of the representative from those of the administrative body, not by a return to the discredited system of the separation of powers, but by retaining the unity of powers in the hands of a single elective body. The governing body must carry out its orders thru a strong, unified, harmonious administrative organization under a strong and expert executive. This will be the real "business plan," and it will be thoroly democratic.

It is on the administrative and executive side that the city-manager plan introduces a radical change. Commission government in the old sense is a five-headed affair. The city-manager plan does away with this five-headed feature and substitutes a single head, not with advisory powers merely, but, under certain safeguards, with the powers of administrative "life and death" thru actual control of appointments and removals.

The chief executive or city manager is not an elective officer, but is appointed by the council; he, therefore, does not divide responsibility with the council, but is subordinate to it; he need not be, at the time of his appointment, a resident of the city, but may be chosen from anywhere in the country; he is not chosen for a definite term, but holds office so long as he gives satisfaction to his superiors. The controlled-executive plan filters everything thru a group. It reduces the personal equation. Without loss of administrative unity, it abolishes one-man power. This officer corresponds to the general manager under the board of directors in a business corporation. It gives the stability of the combined judgment of many men on matters of policy, but leaves execution to a single-headed controlled executive establishment. It is the universal plan in corporations and in all associations employing paid servants. It is likewise a standard plan in governments outside of the United States.

In some foreign countries parliament elects and controls the prime minister, who in turn controls the administration. The magistrate of a German city, with general power of appointment over the whole administration, is hired by the council and subject to continuous control by it.

For the highest efficiency we must put the chief administrative official, as well as subordinate officials of the same sort, on a professional basis, and take the matter out of politics by relieving him of all except purely administrative duties. That is not saying, you will notice, or even implying, that "the people cannot be trusted to choose" the chief administrator; it is implying merely that they are not in a position to do so to advantage.

In so far as a mayor is a mere administrator, he should be supplanted by the city manager, and in so far as he is a deliberative or policy-determining official, he should be supplanted by the commission as soon as that body has been made, by the application of proportional representation to its election, truly representative of all of the voters.

There is every advantage in giving the responsibility for the appointment and retention of the city manager to the council or commission. Instead of changing completely with the turn-over of a few votes at any election, as would frequently happen in the case of a mayor elected at the polls, the council will change in complexion only as fast as, and to the degree that, the whole body of voters changes. Thus the council is the most stable basis for the managership to rest on. Moreover, if the city manager is not to be elected by all the voters, and if he is to be kept in office indefinitely so long as he is satis-

factory to those who appoint him, as is required in the interest of efficiency, it is obviously important, in the interest of democracy, to entrust his appointment and his retention to the one body in the government that can be made truly representative of the whole electorate.

Efficiency and democracy, then, the two fundamental requirements of the ideal city government, are satisfied by the city-manager plan, and accomplish all that its advocates maintain.

The city manager should be a civil engineer with municipal engineering experience, who should also possess the qualifications of an economist, a financier, and have executive ability. What other profession has men who are better qualified as municipal experts than the engineering profession? A capacity to get at the facts in any case, supplemented by good judgment, are predominating traits, characterizing this profession more prominently as essentials than any other profession or calling.

The board of trustees of the city of Inglewood followed the very rational plan of appointing as city manager the writer, who had served as city engineer for two years. In the ordinance passed by the board creating this new position, they delegated practically all of their executive and administrative powers to the city manager, and they have given their personal assurance of their loyalty in anything he may undertake to perfect the organization and place the affairs of the city on a business basis. The ordinance was passed on the 2nd of March, and legally did not take effect until thirty days thereafter, but the board deemed it necessary that I be appointed and assume the duties of city manager at once.

The ideals upon which to erect the superstructure of my organization are efficiency and economy. To make my administration successful in these respects, I was obliged to make quite a few changes in the organization of several departments. Being familiar in a general way with the weaknesses of the various departments, I determined in order to correct them, that the requisites of all employes should be efficiency, economy, honesty and loyalty. Employes who possessed these qualifications are retained regardless of their political faith. A few dismissals were necessary, as this city, like many others, was not without political office holders, appointed regardless of qualifications or fitness. I will not attempt to describe the reasons for the dismissals, but I wish to state that if any of my fellow-engineers ever receive the appointment of a city managership, and they are obliged to dismiss employes, they need not be discouraged by threats and wild epithets hurled at them by "political bosses" and their followers, since this is a natural procedure in the course of uncovering the efficient and economical(?) work of their "pets."

There is an erroneous impression grounded in the minds of many municipal employes that they are not required to do as much work as for a private corporation: They labor under the pretext of the old political saying "to the victors belong the spoils," and are therefore justly entitled to be given employment, and to do whatever they please, irrespective of the quality or quantity of the work performed, or of their value and worth to their employes, or interest taken in the business affairs of the city.

The following is a brief summary of some of the important movements to be undertaken, and changes in the various departments:

1. The removal of inefficient and incompetent men from the city service.

2. Requiring all employes to obtain an order, signed by the city manager, for the purchasing of machinery, tools, supplies, materials, etc.

3. Accounting system installed and providing balance sheets of all accounts.

4. Limiting all city departments to a limited expenditure, and providing for an emergency fund, all within the actual revennes of the city.

5. Monthly detailed reports from each department.

6. Installation of unit cost system, where practical, in all departments.

7. Enlarging and defining the duties and powers of the park commission to exercise control and supervision of all parks and street tree planting, and of beautifying the street and avenue parkways by

the formation of assessment districts to pay the costs and expenses thereof.

8. Arranged with electric light and telephone companies to have poles removed from streets and avenues into alleys.

9. An ordinance prohibiting the trimming of street trees by property owners, and delegating these duties to the park commission, and prohibiting the destruction of shade or ornamental trees, shrubs and flowers, and providing penalties therefor.

10. A resolution providing for the removal of weeds from street parkways, at the expense of the property owners.

11. Commission appointed to revise building ordinance.

12. Commission, composed of five members, one each from grammar school trustees, school teachers, Parent-Teachers' Association, Woman's Club and city manager.

13. Providing more convenient and enlarged quarters for the public library.

14. Establishing more stringent rules and regulations governing the care of buildings and apparatus in the fire department.

15. Increased the efficiency of the building, plumbing and electrical inspectors' department, and placed it on a revenue producing basis.

16. Motorcycle officers ordered to strictly enforce ordinances pertaining to speeding on boulevards, and prohibiting heavy hauling on certain avenues.

17. Arrangement made with fire engineer to co-operate with city marshal's department to receive calls for his department, and thereby greatly increasing the efficiency of the police department.

18. Consolidating the city engineer's and street superintendent's office, which heretofore were entirely separated. The city engineer having charge of all new improvements, while the street superintendent had charge of the maintenance and repairs.

19. The removal of incompetent, inexperienced men from the service of the street department, and placing competent, experienced and able-bodied young men in their places, reducing the force to half the number.

20. Systematizing the work of the street repair and maintenance department, and establishing a unit cost system for the various classes of street work.

21. Provision for a material supply yard adjacent to railroad, and the housing of roller, graders and other implements.

22. Movement under way to require all public utility corporations to take out permits for all street excavations, and requiring a deposit with street superintendent of an amount sufficient to cover the expense of replacing street surfaces to the original condition. Said work to be performed by the street superintendent.

23. The collection of rubbish and garbage.

24. Placing of receptacles for paper, rubbish, etc., along the principal streets of the city.

25. Effected the co-operation of the police department with the health departmen enforcing quarantine ordinances, and the strict enforcement of all ordinances pertaining to the health of the citizens and cleanliness of premises.

26. Compelling all employes to observe the following working hours, viz: 8 a. m. to 12 m., and from 1 p. m. to 5 p. m.

27. Permission must be obtained from the heads of departments before any employe is permitted to leave his regular duties.

28. Requiring an inventory of all office furniture, fixtures, supplies, machinery, tools, material, etc., to be submitted to the city manager.

The ordinance creating the city managership in Inglewood, defines his duties and powers, and gives him authority to exercise control over all departments, but expressly excepts the legal department from the operation of the ordinance. In my opinion, based upon past experiences, this is a serious defect. The city attorney should be under the control of the manager, because there is not a single department in any city which causes more delays in public improvement proceedings than the legal departemnt. These delays are a handicap to the engineering department, oftentimes proving to be an additional expense, which could be avoided if the city manager exercised control over that department.

STREET CLEANING AND REFUSE DISPOSAL

IN PHILADELPHIA

By William H. Connell, Chief of Bureau of Highways and Street Cleaning.

These extracts from Mr. Connell's forthcoming annual report show the advantages of placing an energetic and competent man in charge of a bureau, especially of one with the multiplicity of detail involved in street cleaning, refuse collection and disposal. Street repair is also included in the duties of the bureau and the results show the same energetic attention to details of operation shown in that branch of the work.

THE street cleaning contracts, which include the collection of ashes and rubbish, were operated during 1913 for the first time under the revised specifications. The street cleaning specifications, instead of containing the indefinite requirements characteristic of the former specifications, are entirely definite in character, and stipulate in a clear and concise manner what is required of the contractor. The frequency of street cleaning, the number of blockmen and the amount of certain classes of equipment is definitely stipulated, and as a result work under the street cleaning contracts was not only performed better than in former years, but was capable of more exact control.

In the supervision of the contracts for street cleaning a radical departure was inaugurated by handling the inspection of the work thru the district engineers, thus making the street cleaning an integral part of the general highway work. The former administrative method of handling this work thru a separate division of the bureau, naturally resulted in a considerable duplication of effort, which has been entirely eliminated with the existing organization, thus not only giving a more adequate inspection, but also reducing the cost of this service.

At the beginning of 1913 the bureau was in the unfortunate position of having almost no data relative to the amount of cleaning performed, the amount of materials handled and other essential information pertaining to this work. During the year special investigations and studies have been made for the purpose of obtaining data, so that the bureau records now show what work is being performed under these contracts. In addition to the obtaining of street cleaning data much work was necessary in perfecting the engineering details of operation. Definite studies were made of the schedules of each class of work performed on the different streets and the work under these contracts has now been so systematized that not only is the frequency of cleaning on each street formulated, but the character of street cleaning machinery to be used on each street, the amount of cleaning required and such other matters have been definitely regulated. These studies are by no means completed, but the work that has been done, together with the plans projected for 1914, will place this work on a basis comparable with the up-to-date municipalities, so far as is possible under the contract system.

The uniforming of the men employed under these contracts has marked a new era in street cleaning work in Philadelphia, and has met with universal approval; for, aside from the generally pleasing appearance of the "white wings," there has been a marked advance in the esprit de corps among the men, which has raised the standard of the work performed and last, but not least, the innovations inaugurated in conducting this important branch of the municipal service

STREET CLEANING *in Philadelphia. Squeegee gang preceded by sprinkler.*

have placed the contractors on their mettle and have tended to arouse their pride in the work in their respective districts; and thru promoting friendly rivalry among the contractors, it is hoped that the standard of their respective organizations will be improved, which will not only give them a more complete control over their work, resulting in a direct economy to them, but will generally improve the service rendered to the city.

The standard of the equipment has also been materially improved during 1913 and thru a strict enforcement of the new provisions in the specifications that all equipment shall be kept clean, and stipulating a fine for violations of this requirement, it is expected that the sightliness of particularly the ash and rubbish wagons, will be greatly improved during 1914.

The street cleaning work, of course, involves so much detail for which there are no definite units to specify and bid for, and furthermore it is of such a character that the overhead charges for proper inspection are disproportionate to the cost of the work, that unquestionably it could be much more effectively and economically carried on directly by the municipal forces instead of by contract. It might be well in passing to call attention to the fact that of the twenty-five largest cities in the country, Philadelphia is the only one which performs this work under the contract system, and if legislation could be obtained permitting the work to be done by municipal forces, much better results could be obtained.

It is fully recognized that effective work in cleaning the streets and disposing of waste cannot exist without co-operation of the general public, and an effort has been made by the bureau thru means of the different civic and business men's associations to reach the people in an endeavor to obtain their co-operation, and while much improvement is still possible it is felt that a substantial advance has already been made along these lines.

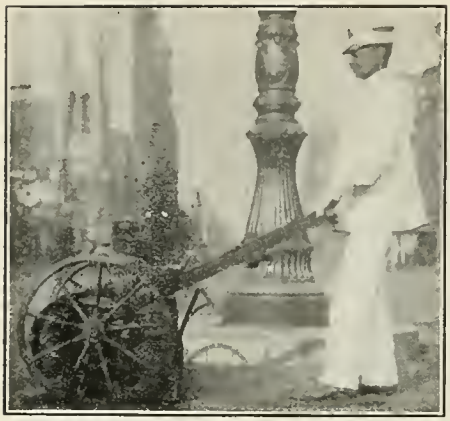
In connection with this educational campaign, 1,490 waste paper receptacles were placed in prominent locations thruout the city and they have proved such a success that it has become apparent it will be desirable to place about five times as many more of these cans at suitable locations thruout the city, such as, for example, two in every block in the principal business section, in front of all school houses, entrances to elevated

STREET CLEANING *in Philadelphia. Sprinkler and two machine brooms, followed by the gutter cleaning gang pick-up carts shown in the photograph below.*

and subway stations, etc., during 1914. Several circulars have been sent to each householder thruout the city, containing important information and instructions designed to improve conditions with regard to suitable and uniform receptacles; the separation of ashes from rubbish, and other matters in which the co-operation of the householder is required. In addition to these circulars, bulletins and letters of information have been distributed among the Business Men's Improvement and Civic Associations, for it is fully recognied that effective results in street cleaning work can only be accomplished thru such co-operation, as the individnal can probably best be reached thru associations of this kind.

As one of the most effective methods of reaching the householders is thru the women's organiations, a woman inspector was appointed to keep in touch with the activity of women's clubs and to secure their co-operation in this work. This inspector has, during the year, given over two hundred lectures to various organiations, and has enlisted the co-operation of householders, women and children in connection with preventive street cleaning measures, thru club, church, settlement and school meetings. The housekeeper has been shown how vital is her part in an efficient system of collection of all wastes. Children have been impressed with their duties as citizens and given a welcome responsibility in demon-

GUTTER CLEANING *and pick-up gang.*



BLOCKMAN *with hand machine broom.*

strating their knowledge in the home, school and on the street, and as a reward for such activity five thousand buttons have been distributed in six months. To assist in the promotion of this work, 20,000 folders for children and adults, relating to the care of the streets and the collection of wastes, were put into circulation and a ready response has everywhere been manifested.

The new housing law enacted during the year has given the city the right to standardize the type of receptacles used for ashes and rubbish and the 1914 specifications require the householders to use receptacles of a proper standard.

A special effort was made in the latter part of 1912, and continued in 1913, to compel the householders to separate the ashes from rubbish and waste. In other cities the rubbish is a source of considerable revenue, which is now being lost to Philadelphia, owing, primarily, to the proper separation. In the specifications for 1914 a provision has been made for

BLOCKMAN *with improved bag carrier for sweepings.*

UNIFORMED FOREMAN *of street-cleaning gang with bicycle.*

failue of the householders to make the the rubbish delivered on the street cleaning dumps to become the property of the city, and it is proposed to offer this rubbish for sale to the highest bidder. While the rubbish will not have any great value at first, it should within a year or two—when effective separation of waste is obtained and the scavengers are eliminated—yield a return of $100,000 a year. Many of the details of this work, however, cannot be permanently bettered until new legislation is obtained, which would be effective in preventing operations such as scavenging, sweeping and throwing materials into the street, prohibiting overloaded vehicles, etc. Legislation does exist regulating most of these matters, but

RUBBISH WAGON *of Philadelphia standard type. Note rubbish boxes near horses, rubbish barrels at rear of wagon and ash cans at extreme left; all set at edge of sidewalks to wait for the wagons.*

the laws are not sufficiently drastic to enable the bureau to properly control the situation.

The week of April 28 to May 3 was set aside as a special "Clean Up" week, to better the health conditions and appearance of the city. In order to bring it to the attention of property holders, the plan was advertised as widely as possible, thru the daily papers and pamphlets distributed to every householder. In addition, placards were placed in store windows, trolley cars and railroad stations calling attention to this movement. Every possible means of obtaining active co-operation was used, the civic organizations, public schools, Boy Scouts, all enlisted their services in this work. During "clean up" week the amount of rubbish collected by the city amounted to 34,379 cubic yards. The refuse spread out on a city square 300 by 300 feet, would rise to a height of 29 feet, or the height of a two-story dwelling. With the plan to make "clean up" week a yearly affair, it is believed that this work will materially improve the health conditions of the community as well as the sightliness of the streets.

As a result of the detailed studies of street cleaning made during the year, the schedule of frequency of cleaning specified for work during 1914 was placed on a more practical basis than in the 1913 specifications, which were drafted without sufficient data being available to form a proper basis. The 1914 schedule has been so revised that the actual yardage to be cleaned each day has been slightly reduced, and yet the distribution of the cleaning has been so arranged that much more effective work will be performed during the coming year. The number of blockmen employed in each district was also reduced on an average of about twenty per cent. Notwithstanding this, with a more thoro control over the manner in which they are distributed and carry on their work, together with the better grade of men that is required under the 1914 specifications, it is believed that this smaller force can actually accomplish as much, if not more, than the larger force did during 1913.

The detailed studies which were made during the year were also of great value in determining the actual cost of the work to the contractors. When the 1914 work was advertised and bids were received, it was found that the low bidder in six of the eight districts bid a price which represented a fair cost and fair profit for the work, but that the bids received for the other two districts were excessive. These two districts were, therefore, readvertised

ASH WAGON *of Philadelphia, standard type.*

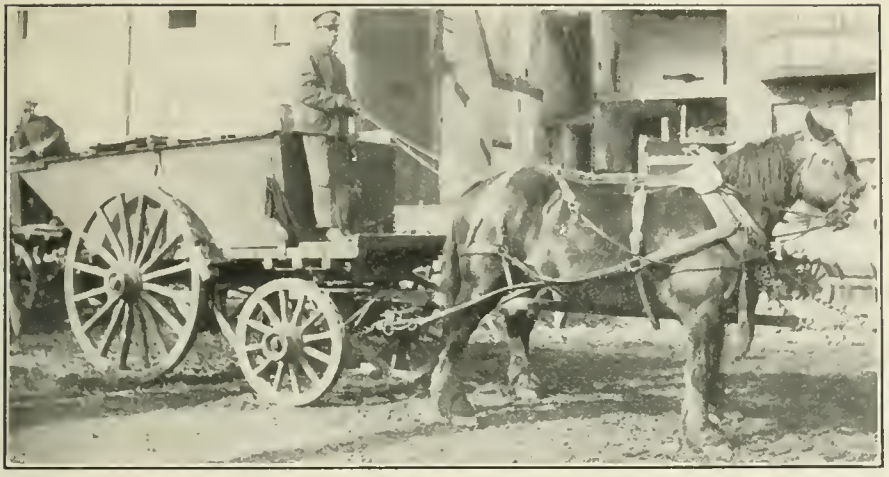
and the bids received at the second letting aggregated $51,700 below the bids first received. This saving is a clear indication of the value and importance of collecting data on this class of work thru engineering investigations.

The garbage contract—like the street cleaning contracts—was operated in 1913 for the first time under the revised specifications and the work, as was also the case with the street cleaning, was placed under the jurisdiction of the district engineers.

The American Product Company was awarded the contract for collecting garbage during 1913. The contract was operated satisfactorily for the early months in the year. In the summer, however, there were rumors that this company was financially embarrassed and as a result the operation of the contract became unsatisfactory in August, and the conditions were so bad in September that the contract for collecting and disposing of garbage was cancelled and the work was given to another concern, at a slight advance in price over the former contractor. During the year a special effort was made not only to better control this work thru more careful inspection, but to obtain data in regard to its operation, which heretofore has been lacking.

It is unfortunate that the contractor who first did the work in 1913 was not able to continue in business, for with only one concern now operating it will be difficult to obtain competition in bidding for this work in the future years. It is particularly fortunate, however, that the contract was advertised and bids received for the 1914 work in July of 1913, as this insured competition and resulted in obtaining a fair price for the work which in all probability would not have been the case had it been advertised at a later date, as the financial troubles of the American Product Company left only the Penn Reduction Company in the field without a competitor. This branch of the service can never be put on an efficient working basis until provision is made by legislation either for a long term contract, or for the city to erect and operate its own disposal plant, which is preferable.

Another condition making it difficult to properly handle this work is the operation of the private collectors. It is estimated that at the present time about half, and, of course, the best half, of the garbage is taken by private collectors, which not only makes it more difficult for the contractor for garbage collection and disposal to operate at a profit, but makes the situation difficult to control, as a very large proportion of the complaints received by the bureau are found, upon investigation, to be due to the improper



GARBAGE WAGON *of Philadelphia, standard type.*

work of these private collectors. Legislation regulating and restricting the operations of these collectors is very much needed and it is hoped that the efforts now being made to eliminate "piggeries" will in a larger degree affect the activities of these private collectors.

PROFITABLE CONVERSION OF CITY GARBAGE

By a London Correspondent.

A METHOD of garbage disposal which is finding considerable favor in England and which has been adopted amongst other towns in Southwark, Hove, Halifax, Blackpool, etc., consists in converting the house refuse collected by municipalities into a marketable fertilizer. The plant comprises a patent disintegrator or dust manipulator, a conveyor and an electric motor for driving. At Southwark, London, there are four sets of the machinery which are erected in pairs, the two pairs facing each other, the conveyors conveying towards the center and discharging the output into a railway truck for immediate dispatch. The whole space occupied by the plant is only some 50 feet by 20 feet and no costly buildings are required. The machine which actually does the work is the dust manipulator which is a strong and powerful centrifugal force disintegrator. The dust carts tip their loads on a sheltered platform some 20 feet by 12 feet, where large tins and leather, which fetch a good price, are thrown aside by the workmen, while the remainder, including broken glass, crockery, slates, wood, and small tins, in one word, the whole of the unpicked refuse, is shovelled into the hoppers of the machines for treatment. In a second or two after entering the machine the house refuse finds its way out and falls on the conveyor in a uniform mass which cannot well be distinguished from dark, rich loam. Occasionally, a few very small bits of paper appear here and there on the surface, but these disappear very quickly owing to the disintegrating action of a rapid fermentation accelerated by the pounding the refuse received while passing thru the machine. One very noticeable point is that immediately after treatment this mass, which previously had a most unpleasant smell, has entirely lost it and is not objectionable. The stuff thus treated is now ready to be spread at once on the soil as manure. Of the four dust manipulators at Southwark three are in constant use, one being kept in reserve and used when wanted. We understood that the output amounted to some 70 tons per day, and that the manure sold by the council to farmers and kitchen gardeners in Kent amounts to something like 18,000 to 20,000 tons per year. This manure is sold at 2s. 4d. (56½ cents) per ton. Each machine is capable of treating up to 4 or even 5 tons of refuse per hour. The whole operation is performed in a manner cleanly, quiet, and free from any suspicion of nuisance, and the economical principle of giving back to the soil what comes from the soil is put into practice.

PROFITABLE SMOKE PREVENTION

By W. C. Kirkpatrick, Chicago, Ill.

The author is a close student of the subject of smoke prevention and possesses a thoro knowledge of the principles of combustion. His statements in this article are striking and will attract the attention of those who are interested in alleviating one of the nuisances of modern city life. While engineers and scientists may not in all cases be in agreement with the author's views, and while it is possible that the author may have over-estimated the extent of the nuisance produced by smoke, the article contains many points of interest and value to the student of the problem.

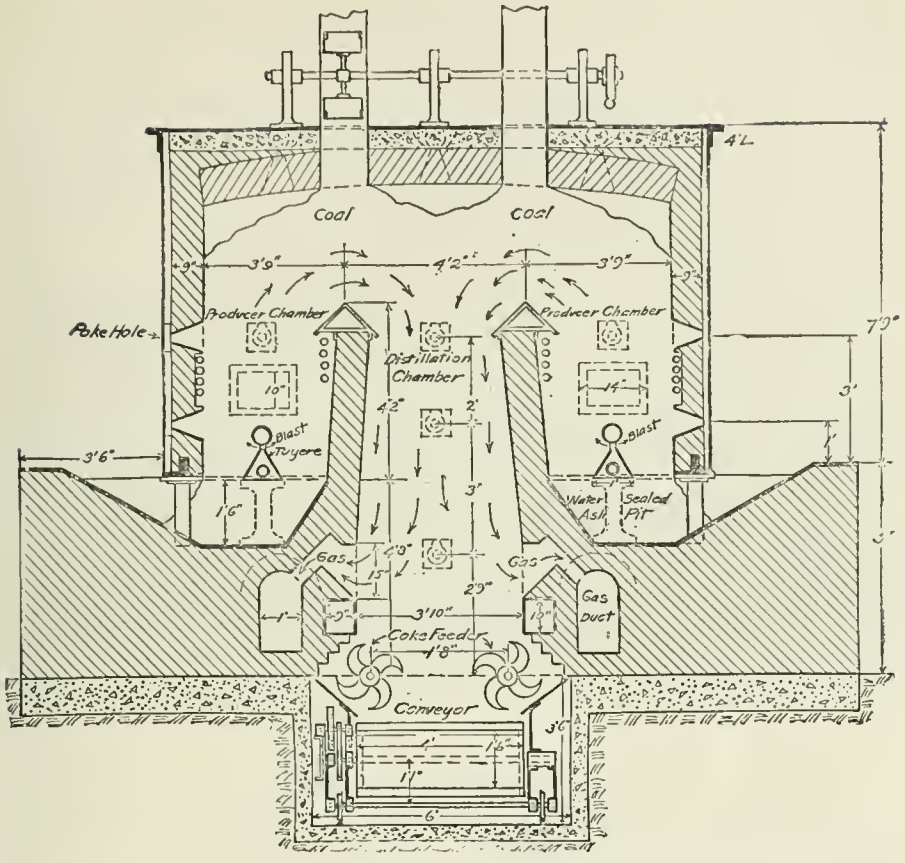
IN the May issue of MUNICIPAL ENGINEERING, the writer endeavored to show what losses are caused by the generation of smoke. Not only do we lose this value direct (which is approximately five million dollars per year), but we have another loss in the damage from the result of the smoke. In fact, it is almost impossible accurately to estimate the loss due to smoke thruout our cities where soft coal is used.

The soot and tarry matter deposited from smoke constantly adds large volumes of filth to the streets, to the windows and doors, to the out and inside walls, to furniture, decorations, etc., and constantly keeps thousands of people at work cleaning, which great expense could he avoided by the use of smokeless fuel.

Many plants have been erected and successfully operated for years to distill, carbonize or coke coal hut nearly all of the successful plants are very expensive in first cost, making it prohibitive to many industries, furthermore, they operate periodically, instead of continuously and hence do not produce uniform products and most efficient results. Professor E. J. Babcock, dean of the School of Mining Engineering at the University of North Dakota, has designed, erected and placed in successful operation a plant for carbonizing lignite coal in which the heavy hydrocarhons are extracted from the gas as it leaves the retort, remixed with the carbon, and briquetted, resulting in the production of a high grade domestic fuel, a weather-proof briquette with almost the same heating value as anthracite. The gas and other by-products are also available for commercial purposes.

The idea is not new, but the method employed to ohtain low temperature distillation continuously and automatically is new, altho based upon two old and well-known undisputed facts: First, that ordinary producer gas is produced at a high temperature and leaves the producer at not less than 1000° F. and all free oxygen admitted in the producer is consumed in the production of producer gas; second, ordinary bituminous and lignite coals distill at a low temperature or commence to distill at 212° F. and if in direct contact with a gas at 700 to 1000° F., distilling very rapidly.

Therefore, by erecting a rectangular chamber with two partitions extending part way up toward the top, dividing the base into three distinct and separate chambers, all being fed continuously and automatically, and by having the gas exhauster and the outlets at each side near the base of the central chamber, then by operating the two outer chambers as ordinary producer-gas chambers in the production of high temperature, low value gas, the gas rises to the top of the partition and is drawn down thru the fuel in the central or distillation chamber. As each cubic foot of this gas contains large quantities of sensible heat, and as the heat is applied to the coal in the central chamber in the absence of free oxygen,



SECTION OF FURNACE *producing distilled coal and fuel gas from bituminous coal.*

the coal in this chamber is distilled, giving up a portion of its volatile in the form of coal gas, which mixes with the producer gas, forming a combination of coal and producer gas. The combination gas passes down thru the lower bed of distilled coal, which partially acts as a scrubber on its way to the exit. Hence the hot producer gas is cooled and converted into a combination gas or enriched in the distillation process. In actual practice, 10 per cent. of the total quantity of coal delivered into the generator is consumed in the production of producer gas, and the heat liberated in this reaction in evidence as sensible heat of the gas is sufficient to distill the 90 per cent. as it passes down and out thru the central chamber.

The distilled coal passes downward by gravity onto a traveling grate and discharges thru a water seal to the outside. This coal is subjected to a temperature of from 600° to 1000° F. for about one hour, and is in direct contact with and entirely submerged in a constant flow of high temperature gases, rapidly reducing in temperature as it passes downward.

The writer wishes to lay emphasis on the fact that this resultant fuel is not coke, but semi-coke which still retains sufficient volatile constituents to permit its use in an open grate, hot air furnace, hot water furnace, base burner, and for the generation of steam. The product burns with a bluish white flame and does not produce smoke, hence, it is smokeless and free from moisture, clean and a high-carbon fuel, a fuel every consumer desires. Not a furnace would have to be altered in order to successfully use a product of this quality. The railroad locomotives could

successfully use it. It is lighter in weight than coal, but it is much higher in heating value in proportion to its weight.

In the use of one ton of ordinary bituminous coal, the process produced in practice approximately 22,500 feet of 320 B.t.u. gas with the gas leaving the generator below 300° F., and a by-product of 1,460 pounds of distilled coal. The coal used in this test contained approximately 30 per cent. volatile and cost $2.50 f. o. b. cars Chicago, while the 1,460 pounds of smokeless fuel displaced approximately 1,400 pounds of Pocahontas coal which costs the small dealers in car lots, $5.50 per ton f. o. b. cars, and which they retail in ton lots at $7.00 to $7.50.

Should the manufacturer who now consumes fifty tons of bituminous coal per day adopt this method, he would produce approximately the following results:

The average coal consumption is below 50 per cent. efficiency or at the point of combustion, fifty tons of 12,000 B.t.u. coal would generate 600,000,000 heat units at 50 per cent., and if this coal cost $2.25 per ton, f. o. b. cars, the total fuel cost would be $112.50 per day. To displace the heat required by combination gas they would use in gas generation and distillation approximately ninety tons of bituminous coal, which would generate 22,500 cubic feet of 320 B.t.u. gas per ton, or 648,000,000 heat units in gas and this gas can be applied on the basis of 90 per cent. efficiency at the point of combustion. Hence the gas from the volatile in ninety tons of coal will displace the heat as produced by consuming the total value of fifty tons of coal, and in the process of generating the gas, produce sixty-three tons of smokeless fuel, which has a wholesale value of $4.00 or a retail value of from $6.50 to $7.50 per ton.

Operation.

63 tons of distilled coal ..... f. o. b. cars plant.	@$4.00		$252.00

Operating Expense.

90 tons of bituminous	@$2.25	$202.50	
Labor and Operating expense	@ .25	22.50	
Depreciation	.10	9.00	
Interest on investment	.05	5.00	238.00
Total daily net profit			$ 13.50
Add to this the cost of 50 tons of coal per day as now being consumed, labor, etc., which will show the net saving as follows:			
50 tons @$2.25			$112.50
Labor, 50 tons @25 cents			12.50
Total daily saving			$148.50

It is no doubt difficult for the average manufacturer to understand how he could save $13.50 more per day than his present method costs him, but if he will study the commercial value of the by-products present in the volatile matter in the coal, he will appreciate the fact that he is now converting this value into smoke, thereby resulting in a great loss of efficiency, and be willing to co-operate in the development of this process for the solution of the smoke nuisance, and for the economical utilization of coal.

ORNAMENTAL LIGHTING IN SEATTLE

NITROGEN-FILLED TUNGSTEN CLUSTER LAMPS

THE lighting department of the city of Seattle, thru its superintendent, J. D. Ross, recently installed the new system of nitrogen-filled tungsten street lights. For the ornamental lighting system, as shown in the accompanying photographs, there are 1,692 cluster lighting poles of this type, of which 1,179 carry five lamps each, 377 three lamps each and 137 one lamp each. The total extent of the streets lighted by this system is twenty-five miles.

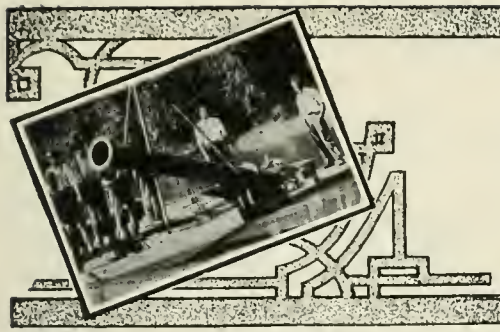
The lights used on the poles shown in the illustrations are from 50-watt, 8-volt, 80-c.p. lamps. Each pole carries a 250-watt 125-volt to 8-volt transformer in its base. The advantage of this system of distribution is that it makes possible the use of a low voltage type of lamp, which, on account of the shorter and sturdier filament, gives a much longer useful life.

Before the nitrogen-tungsten was introduced, an older type of 8-volt tungsten lamp was used on these poles, and the average life of this lamp for the past two years has been 4,100 hours. In a test of forty nitrogen lamps installed December 10, 1913, five burned out up to April 7, 1914, after burning 1,620 hours, and of these two were broken, so that it is anticipated that the nitrogen lamp will be nearly as durable as the older lamp.

The globes used are opal glass and give almost perfect diffusion and the light from the nitrogen lamps is notice-

ably whiter than that from any of the other lamps on the street. With five 80-c.p. lamps per pole and the poles spaced at 80 and 90 feet, the illumination on the street is more than ample.

This same type of lamp is used on "goose-neck" fixtures on the series lighting circuits that supply the outlying districts of the city. A larger unit of the same type is now being tried out to take the place of the series arc lamps which have been used heretofore. This larger lamp gives 600-c.p. and is far superior to an arc lamp in amount and distribution of light. If it proves sufficiently durable it will probably be adopted as standard, as the smaller unit of the same type has been adopted. These 600-c.p. lamps are now in use and are simply elegant, to use the expression of Mr. Ross.



EDITORIAL

PROTECTING THE PEOPLE

The newspapers of Birmingham, Ala., have had full reports of the conferences between the city commissioners of that city and the officials of the gas company over an offer of the latter to furnish the city and its citizens with by-product gas with a minimum of 525 heat units at rates, reducing as the total consumption in the city increases, from 75 cents to 50 cents per 1,000 cubic feet. The present rate is 95 cents with certain small discounts. The new rates provide for a sliding scale according to individual consumption, so that a large consumer gets a rate some 15 cents less than the above rates. The present standard of quality of the mixed coal and water gas now furnished is 575 B.t.u.

Taking account of the difference in quality, it has been computed that the citizen, on the assumption that a reduction of one step in the rate was made each year, would save in six years nearly $1,600.000.

The company's offer did not include a payment to the city treasury, and, the city commissioners, considering the condition of the city treasury and the fact that the operations of the company in the city's street place on the city a burden of expense for inspection and for street repairs and increased cost of street construction, required a payment of this sort.

The contention of the company that it could not afford to make this payment at the rates offered was supported in part by the consulting engineer of the city, and a compromise proposition was finally made which would increase the rates offered by the company by 1 cent each and would require the company to pay the city 2 per cent. of its gross receipts from its gas business. The tax would thus be divided between company and consumers, but when the lowest rate was reached would all be paid from the 1-cent increase in rate. This plan would give the city more than $100,000 in six years on the estimate above quoted, and would still save the consumers of gas in the city nearly $1,500,000 in that period.

Two of the commissioners refused to consider the proposed increase in rate, demanding that the company pay the entire 2 per cent. on the ground that they would protect the citizens from an indirect tax of this nature.

The company refused to pay the entire tax and announced its intention of continuing the present rates and supply of gas during the remaining seven years of its present contract.

The inquiry most pertinent under this statement, made up from the newspaper reports and interviews with officials and engineers, is this: Is the refusal of an offer which will save the consumers of gas, say $1,500,000, because the company refuses to pay the city some $100,000 during the time of the contract, a protection of the citizens in any sense in which that term can be used?

The ultimate rates offered are the lowest yet offered in any city in this country for manufactured gas for all purposes, and, when the difference in quality is taken into account, are lower than those in any other city, except Indianapolis.

MUNICIPAL MOTOR CAR CONSTRUCTION

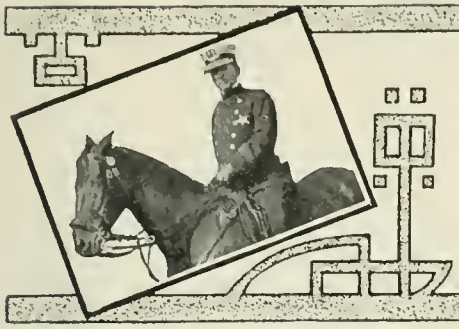
The article entitled "Chicago Builds Motor Cars," which appeared in the June issue of MUNICIPAL ENGINEERING, has aroused some comment as to the economy of a practice of the kind described when applied as a policy to cities in general.

Some very decided views have been expressed upon the subject, the consensus of opinion being apparently that any city, no matter what its size or requirements, is not in position to build or assemble its motor-driven equipment at as low a cost as can a manufacturer who confines himself strictly to this class of work. Especially would this be true were the policy extended to cover fire apparatus as well as ambulances, patrols and motorcycles. Even when all parts are bought and assembled the cost of the work is regarded as prohibitive when the matter of efficiency and ultimate service is taken into consideration.

The truth of this fact is well borne out when it is considered that a few years ago fire apparatus builders started out by buying regular pleasure car and commercial truck chassis and mounting the auxiliary equipment upon them. The comparatively low cost at which it is possible for these manufacturers to supply their equipment made it particularly attractive to many cities, but the records of the fire departments, for instance, where these machines have been in service, prove conclusively that this practice, altho carried on by a factory, was costly, not only to the buyer, but to the manufacturer. It was found that such equipment was not sufficiently strong to withstand the hard service demanded of it, and as a result the breakage of crank shafts, cam shafts, wheels, axles and other vital parts, which were never designed for high strain, has been responsible, not only for an unusually high maintenance cost, but for a poor and inefficient service as well.

It is true that some manufacturers of high-grade fire apparatus are also manufacturers of pleasure cars, but it will be seen that in most such cases there has not been an effort to adapt the lighter equipment to the requirements of the heavier service.

In view of all the facts bearing upon the subject, it would seem wise for any city to give the most careful possible consideration to all the factors entering into the problem before adopting and putting into effect any plan for building or assembling its own equipment which will result in a high cost and an unsatisfactory operating service eventually.



QUESTION DEPARTMENT

Non-Corrosive Metal for Spraying Nozzle Wanted

We herewith have a question for your Questoni Department:

WANTED—A metal that will take the place of brass for nozzle to be used for spraying purposes in an irrigation system that will not be much more expensive than brass and which will corrode less. B., Chicago, Ill.

Have our readers anything to suggest?

Waterproofing Paint for Cement Block House

Please send me the address of some good waterproofing company. I want to paint my house outside with it. My house is of cement block. I would have about 1,200 square feet to cover. N., ———, S. D.

The Antakwa Co., Chamber of Commerce, Chicago, Ill., H. W. Johns Manville Co., New York, the Sandusky Portland Cement Co., Sandusky, O., or the Trus-Con Laboratories, Detroit, Mich., can probably supply what is wanted. Others from whom such materials can be obtained are Samuel Cabot, Boston, Mass.; Smooth-on Mfg. Co., Jersey City, N. J.; Aquabar Co., Philadelphia, Pa.; Ceresit Waterproofing Co., Chicago, Ill.; Geo. W. DeSmet, Chicago, Ill.

How to Build Concrete Houses

Could you advise me where I can obtain some information concerning poured concrete houses, especially small, inexpensive houses, to be used as miners' dwellings?

M., ———, N. M.

Possibly the Edison poured concrete house is in mind. This has not been developed as a very practical method, altho the walls for concrete houses are made monolithic or hollow by the use of movable forms which can be used again and again, in raising the wall until to the desired height.

The Association of Portland Cement Manufacturers, Philadelphia, Pa., the Universal Portland Cement Co., Chicago, Ill., the Atlas Portland Cement Co., New York City, the Sandusky Portland Cement Co., Sandusky, O., all have publications giving more or less information and instruction concerning methods of building concrete houses.

Information can also be obtained from the manufacturers of wall forms, clamps, molds, etc., such, for example, as Reichert Mfg. Co., Milwaukee, Wis.; Insley Mfg. Co., Indianapolis, Ind.; Trussed Concrete Steel Co., Youngstown, O.; Concrete Sand & Stone Co., Youngstown, O.; J. H. Sullivan, Grand Rapids, Mich.

Any of our readers specially interested in the matter will be put into communication with our correspondent.

Wording of Park Signs

Can you give any suggestions for the appropriate wording of signs to be placed in public parks, S., South Orange, N. J.

Suggestions for striking and original signs for park purposes are invited from our readers. For example, one city has small signs set on steel pins which are readily movable from place to place, which have simply the word "Please" on them. These signs are set up where paths are being worn, where grass is being cultivated or elsewhere when, for any reason, the public should for a time be kept off a space or a line. They are removed when no longer needed.

Who Makes Corrugated Tampers?

Please give me the name of any firm advertising or selling corrugated tamps.

F., Greenville, Tex.

The Lourie Manufacturing Company, Springfield, Ill., makes a tamping machine in which various forms of tampers and cutters are used. The Barber Asphalt Paving Company, Iroquois Works, Buffalo, make paving tampers. Warren Brothers Company, Boston, Mass., can also supply them. Harold L. Bond Company, Boston, Mass., make the Andrews concrete tamper. W. H. Anderson Tool and Supply Company, Detroit, Mich.; Ransome Concrete Machinery Company,

Dunellen, N. J.; Dunn Manufacturing Company, Pittsburg, Pa.; Union Elevator and Machine Company, Chicago, Ill., can also supply what is wanted.

Ordinance Prohibiting Free Lunch with Sale of Liquors

Have you any reference to any city ordinances prohibiting the giving away of a free lunch in connection with the sale of intoxicating liquors, under license?

L., City Attorney, ———, Wis.

Can our readers refer us to any ordinance on this subject which has stood the test? This is one form of a difficult question and the tendency has been against the validity of such ordinances in the absence of constitutional or legislative action to exactly the same effect.

How to Get an Education in Municipal Engineering

I am employed in the water department of this city, where my duties, besides looking after the meter system, consist of helping the engineer survey and run levels, and inspecting drainage and plumbing. I have every advantage offered me in the way of technical books, the methods employed in surveying, etc., and I have come to the conclusion that I am to study the profession of municipal engineering. I was educated in Scotland, being a graduate of Kings College, Aberdeen, Scotland, and I firmly believe that I can make good. What I want is your suggestions as to the best methods to pursue, such as taking up a regular correspondence course, or studying what is now at hand. I believe there is a good field for good men in such work, and if you can offer me any suggestions, which no doubt with your vast experience you can, they will be highly appreciated and acted upon.

C., ———, Iowa.

The nature of the education should depend upon the age, ambition and abilities of the student. One can greatly improve his condition as an employe by following a correspondence course, and even give himself a basis for fairly good success in design and construction of new work, but for high-class professional engagements the fullest preparation is becoming more essential each year, and this can be obtained only by attendance at a good technical school supplemented by the best experience obtainable.

The study of books while in subordinate positions is an excellent preparation for the technical school work, especially if it is made under some guidance from an expert. The ordinary text-book used by a correspondence school is rather elementary and is liable to be superficial, but it lays out the course of study, and, if supplemented by thoro reading of the best books in the respective lines is of material aid to the earnest student. If he keeps in mind the possibility of attendance at the technical school, even if that attendance must be intermittent, and keeps in touch with the work and the teaching force in it, the rapidity and the soundness of the advancement will be increased.

Ornamental Lights at Cost of Abutting Property

Please advise if you know of any city where ornamental street lighting standards have been installed as a local improvement, the cost of installation being assessed against the owners of property abutting on the street improved by such ornamental lighting system.

Also please advise if you know of any city where the cost of lamp standards for ornamental street lighting has been included in the cost of city work, or perhaps, as a part of a public movement and paid for by assessment charged against the abutting property.

D., Mayor, ———, Ill.

California cities and even unincorporated towns and country districts can instal lighting systems by assessment on the property, as described in MUNICIPAL ENGINEERING for June, vol. xlvi, p. 510. Possibly the DeKalb, Ill., installation, shown on p. 385 of the same volume was so paid for.

Billings, Mont., forms lighting districts and assesses the cost on the property, as described in vol. xliv, p. 15.

Will our readers cite other cases within their knowledge?

In some cases ordinances are passed making the movement a public one, but in many of these cases the stubborn owner or tenant could not be forced to pay in case he refused, the movement being somewhat in advance of statutory provisions.

In cities where the method of assessment is not possible the installation is made by agreement. In some cases the lighting company puts in the lamps and charges the property owner or lessees a certain rate for the light, as in St. Joseph (see vol. xliv, p. 51) and Indianapolis in an earlier volume.

In other cities the property owners or occupants pay for the installation of the ornamental lamps by agreement and the city furnishes the light. This arrangement is easily made when the city owns the lighting plant, but is in operation with private plants also, as in Waterloo, Iowa (see vol. xliv, p. 41), Topeka, Kan. (vol. xlvi, p. 282), Fargo, N. D. (vol. xliii, p. 119), Baltimore, Md. (vol. xliii, p. 292).

The terms of installation and other data regarding some seventy cities and towns are given in vol. xliii, p. 309. The lighting company made the installations and the merchants pay for the light in seven cases and the owners in one case. The merchants pay the whole cost in three cases, with some help from the city in a fourth case. The owners pay for the lamps and the tenants for the light in three cases. The owners pay for lamps and the city for the light in

six cases, the tenants joining with the owners in four other cases. The merchants pay for the lamps and the city for the light in four cases. The company installs the lamps and the city pays for the light in two cases. The city pays the whole bill in thirteen cases.

Metric Conversion Tables

Who publishes tables giving the equivalents of the metric system and British measures and vice versa, down to thousandths of inches and hundredths of millimeters; also tables giving decimal equivalents of parts of an inch and millimeter equivalents of parts of an inch? In short, we want tables giving the equivalents of the metric system in the British measure system and vice versa.

B., New York.

Van Nostrand's "Table Book for Civil and Mechanical Engineers" (50 cents), is probably what is wanted.

Individual Septic Tanks

Do you have any data on septic tanks for individual homes?

What I desire, if possible, are data showing dimensions, etc., or information as to where the same may be obtained. Any help, along the above lines, that you can give me will be much appreciated. L., ———, Cal.

Several articles in MUNICIPAL ENGINEERING give instructions on this problem. One by R. Winthrop Pratt in vol. xlii, p. 229, gives plans and descriptions and estimates of cost. The Russell system is noted on p. 347. A brief article with references to earlier articles will be found in vol. xli, p. 42, and a long list of articles is given in vol. xxxvi, p. 241.

Municipal Swimming Pools

Have you any information about municipal swimming tanks; that is, what cities are operating same?

It seems to me that swimming interests the average boy as much as anything, and I wish to look into the matter.

Any advice that you can give me will be greatly appreciated.

C., Decatur, Ga.

Boston, New York, Chicago, Rochester, N. Y., are among the cities having public swimming pools in operation the year round. There are many cities which make provision for swimming pools in summer under proper supervision and care, such as Cincinnati, St. Louis, Milwaukee, Indianapolis, Cleveland, etc.

Will our readers add names to these lists?

Parking Down Center of Wide Street

The city of Negaunee is thinking of paving a wide street and leaving a narrow strip in the center to be planted or sodded. Do you know of any city that has a street paved in such a manner?

E. G. STERLING, City Engineer.

There are many cities which have such streets, some of them boulevards and some simply residence streets. The City of Indianapolis, Ind., has a number of streets so laid out for short distances. Some Chicago, Ill., boulevards have used this plan. Detroit, Mich., has used the plan to some extent. Sometimes the street railway tracks are laid thru the central parking strip, as on some streets in Boston, Mass.; Rochester, N. Y., and Birmingham, Ala. See the short street in the article on Baltimore (Roland Park) pavements on another page in this issue of MUNICIPAL ENGINEERING.

This plan works quite well in some cases, but several objections can be made to it, especially as applied to fairly level areas. Thus each of the driveways should be about 18 feet wide, to allow for passage with vehicles standing at the curb, making a total width of paving of 36 feet, whereas a single driveway in the center of a residence street need not be more than 28 feet. The curb around the central grass plot is an extra cost. Unless the park department assumes the care of these central grass plots, their maintenance depends upon the interest taken in them by the residents and they are very irregular in appearance. The park department is likely to object to assuming the work of taking care of the plats, because it is quite expensive, as compared with the cost of caring for like areas in parks. Where droughts are probable, the watering of these plats is not easy.

For these reasons some cities have abandoned this form of improvement and prefer a single driveway in the center, sidewalks at or near the lot lines and wide tree-planted lawns between street curb and sidewalk.

Such a book as Robinson's "Width and Arrangement of Streets" ($2) gives valuable instruction on the general planning of street areas.

Ordinance Regulating Moving Picture Shows

Will you please send me a copy of an ordinance regulating the operation and conduct of moving picture shows, covering the matter of examination and licensing of the operators of the machines. B., ———, N. M.

The New York motion picture ordinance is the most complete one at hand. It reads as follows:

352a. Motion pictures shall be deemed a display on a screen or other device whereby pictures are displayed of characters or objects in motion, whether or not accompanied by music, lecture, recitation or song.

352b. A motion picture theatre shall be deemed any public hall or room in the City of New York in which motion pictures are exhibited, in which the seating capacity does not exceed 600, and in which there is no stage or scenery.

An open air motion picture theatre shall be deemed any public place or space in the open air in the City of New York in which motion pictures are exhibited, and in which there is no stage or scenery.

The Mayor shall appoint such Inspectors as shall be necessary to carry out the provisions of this ordinance. They shall be known as "Motion Picture Theatre Inspectors," and shall be paid such compensation as shall be fixed by the Board of Aldermen on recommendation of the Board of Estimate and Apportionment.

352c. The Bureau of Licenses shall issue all motion picture licenses granted by the Mayor, and by authority of the Mayor shall regulate and control all motion picture theatres, provided:

1. Applicants for motion picture licenses shall file plans and specifications of the motion picture theatre with the Bureau of Buildings of the Borough in which the motion picture theatre is to be situated, and must file a copy of such plans and specifications duly approved by the Superintendent of Buildings with the aplication for the license, which application shall be made to the Bureau of Licenses on blanks furnished by it for that purpose.

2. The Bureau of Licenses shall, without delay upon the request of an applicant, pass upon the location of the motion picture theatre and upon the character of the applicant requesting the license.

3. The Bureau of Licenses shall request the Fire Department, Bureau of Buildings, Department of Water Supply, Gas and Electricity, and Department of Health to inspect said theatres, and the said Departments shall file in the Bureau of Licenses, within ten days, detailed written reports, which shall include a statement of any violations of law, ordinances, rules and regulations, and any dangerous conditions. Upon the failure of any of said departments to file detailed written reports in reply to the request of the Bureau of Licenses, the said Bureau may disregard said Department, and, in its discretion, may issue a license.

4. Until the provisions of this ordinance shall have been complied with, no license shall be issued.

252d. 1. Plans—Before the erection, construction or alteration of a building, or part thereof, to be used as a motion picture theatre, there must be filed with the Superintendent of Buildings complete plans and detailed statement as set forth in section 4 of the Building Code. The plans must show clearly and fully the location and width of all exits, passageways, stairs, fire escapes, aisles, etc.; arrangement of seats, size of floor beams, walls, supports, etc.; the location and construction of the inclosure for the motion picture light and machinery, and for other similar apparatus, a diagram of the lot or plot, showing outlets from all exits, and also such other statements, plans or details as may be required by the Superintendent of Buildings.

2. Prohibition — Motion picture theatres shall not be constructed in frame buildings within the fire limits, nor in hotels, tenement houses of lodging houses; nor in factories or workshops, except where the theatre is separated from the rest of the building by unpierced fireproof walls and floors; and in no case shall they be constructed or operated above or below the ground floor of any building.

3. Exits and Courts—All such buildings must be provided on the main floor of the treatre with at least two separate exits, one of which shall be in the front and the other in the rear, both elading to unobstructed outlets on the street. Where the main floor of the theatre accommodates more than 300 people there shall be at least 3 sets of exits. The aggregate width in feet of such exits shall not be less than one-twentieth of the number of persons to be accommodated thereby. No exits shall be less than 5 feet in width and there shall be a main exit not less than 10 feet in total width.

In all such buildings to be erected or to be altered so as to be used for a motion picture theatre, if unobstructed exit to a street cannot be provided at the rear of such buildings, as herein specified, either an open court or a fireproof passage or corridor must be provided from rear exit to the street front, of at least the following width: 4 feet in the clear for theatres accommodating 100 persons or less; for every additional 100 persons the width to be increased 8 inches. Such passage must be constructed of fireproof material and must be at least 10 feet high in the clear. The walls forming such passage must be at least 8 inches thick, of brick or other approved fireproof material, and if there be a basement the wall on the auditorium side should either run 1 foot below the cellar bottom or may be carried in the cellar on iron columns and girders properly fireproofed according to sections 106 and 107 of the Building Code.

The ceiling of said passage, and if there be a basement, the flooring, must be constructed according to section 106 of the Building Code.

If unobstructed rear exit or exits to a street are provided, the said exit or exits must be of the same total width required

for the court or passage above mentioned.

Said passages and exits to the street, as above, must be used for no other purposes except for exit and entrance and must be kept free and clear.

The level of the open court or passage at the front of the building shall not be greater than one step above the level of the sidewalk, and the grade shall not be more than 1 foot in 10, with no perpendicular rises.

All exit doors must be unlocked when building is open to the public. They must be fireproof and made to open outwardly and so arranged as not to obstruct the required width of exit or court when opened. All doors leading to fire escapes must be not less than 40 inches wide in the clear, and shall be located at the opposite side or end of the gallery from other exit doors.

4. Galleries and Stairs—A gallery may be permitted, but it shall not include more than 25 per cent. of the total seating capacity of the theatre. Entrance to and exit from said gallery shall in no case lead to the main floor of the theatre, and the gallery shall be provided with a stair or stairs equipped with handrails on both sides. Stairs over 7 feet wide shall be provided with centre handrail. The risers of the stairs shall not exceed 7¾ inches, and the treads, excluding nosings, shall be not less than 9½ inches. There shall be no circular or winding staircases.

The total width of the stairs shall not be less than 8 feet in the clear where the gallery accommodates 150 people; for every 50 people less than 150 which the gallery accommodates said width may be reduced 1 foot.

Stairs shall be constructed of fireproof material, and such material and the bearing capacity of such stairs shall be approved by the Bureau of Buildings.

Galleries must also be provided with at least one line of fire escapes leading to an open court, fireproof passage or street, without re-entering the same or any other building.

If the fire escape leads to a point in the court nearer the street than any exit, there must be a width of not less than 4 feet in the clear between the outer edge of the fire escape and the outer wall of the court.

5. Fire Escapes—All fire escapes must have balconies not less than 3 feet 4 inches in width in the clear and not less than 4 feet 6 inches long, and from said balconies there shall be staircases extending to the ground level with a rise of not over 7¾ inches and a step not less than 9½ inches, and the width of stairs must not be less than 3 feet 4 inches.

6. Auditorium and Other Rooms—If the walls of the auditorium contain wood studs, they shall be covered with either expanded metal lath or wire mesh, and plastered with three coats of first-class plaster, or may be covered with metal on ½-inch plaster boards. The joints shall be properly filled with mortar.

The ceilings of all such rooms shall be plastered with three coats of first-class plaster or wire mesh or metal lath, or covered with one-half inch plaster boards, and plastered or covered with metal.

If there be a basement or cellar the ceiling under the auditorium floor must be plastered with three coats of first-class plaster or wire mesh or expanded metal lath, or may be covered with metal on one-half inch plaster boards.

The basement or cellar under the auditorium shall be kept free and clear except the space used for the heating apparatus, for machinery connected with the theatre, and for coal.

7. Construction of Booths—Apparatus for projecting motion pictures shall be enclosed in a booth or enclosure constructed so as to be fireproof, in accordance with the specifications of chapter 756 of the Laws of 1911. The booth shall be equipped with a vent flue, as prescribed in section 352F, paragraph 3 of this ordinance. Booths shall contain an approved fireproof box for the storage of films not on the projecting machine. Films shall not be stored in any other place on the premises; they shall be rewound and repaired either in the booth or in some other approved fireproof enclosure.

Where miniature motion picture machines are employed in connection with private exhibitions the requirements of the above paragraph may be so modified as to permit, instead of the regulation booth, an approved fireproof box, unventilated, and of a size only sufficient to properly enclose the machine.

8. Gradients—To overcome any difference of level in and between corridors, lobbies and aisles, gradients of not over 1 foot in 10 feet, or steps having a rise not over 8 inches and a width of not less then 10 inches must be used.

9. Aisles—All aisles in the auditorium and gallery must not be less than three feet wide in the clear. No aisle, passageway or space in the rear of the auditorium shall be obstructed by any camp stool, chair, sofa or settee, nor shall any person be permitted to sit therein.

10. Chairs—All chairs in the auditorium except those contained in the boxes, must not be less than 32 inches from back to back and must be firmly secured to the floor. No seat in the auditorium shall have more than seven seats intervening between it and an aisle. The space occupied by each person shall be separated from the adjoining space by means of an arm or other suitable device.

11. Signs Over Exits—Over every exit there must be painted on the inside in

letters not less than six inches high, the word "Exit" in legible type, and one red light or illuminated sign must be placed inside over each exit, and illuminated while the audience is present.

12. Floor Loads—The flooring of that portion of the building devoted to the uses or accommodation of the public must be of sufficient strength to bear safely a live load of 90 pounds per square foot.

13. Toilets—Toilets separate for sexes must be provided.

14. Fire Apparatus—Portable fire apparatus shall be provided of the following kind and number: Ten-quart capacity buckets, painted red with the word "Fire" in black, the letters 4 inches high, to the number of six for places seating less than 300 without a gallery, and two additional if there be a gallery; to the number of ten in places seating over 300 persons, and four additional if there be a gallery. There shall be two buckets containing dry sand kept in the operating booth; approved fire extinguishers of 2½ gallon capacity, of the regulation Fire Department pattern, of which two shall be on the main floor and two in the gallery, if there be one, and one in the operating booth; 4-pound flat-head axes, two of which shall be on the main floor and two in the gallery, if there be one.

352c. 1. Lighting—Every portion of a moving picture theatre, including exits, courts and corridors, devoted to the uses or accommodation of the public shall be so lighted by electric light during all exhibitions and until the entire audience has left the premises, that a person with normal eyesight should be able to read the Snellen standard test type 40 at a distance of 20 feet and type 30 at a distance of ten feet; normal eyesight meaning ability to read type 20 at a distance of twenty feet in daylight. Cards showing types 20, 30 and 40 shall be displayed on the side walls, together with a copy of this paragraph of the ordinance.

2. Heating—When the temperature of the outdoor air is below 60 degrees F. the air in the theatre while an audience is present shall be maintained at a temperature not lower than 62 degrees F. nor higher than 70 degrees F.

If gas stoves, oil stoves or other apparatus throwing off products of combustion are used to heat motion picture theatres said products of combustion must be carried to the outside air by means of a fireproof flue or flues.

No radiator shall be placed in the aisles so as to lessen the width below the minimum requirement.

3. Ventilation — Motion picture theatres having less than 200 cubic feet of air space for each person, or motion picture theatres in which the outside window and door area is less than one-eighth of the floor area, shall be provided with artificial means of ventilation which shall supply during the time the audience is present at least 500 cubic feet of fresh air per hour for each person.

Motion picture theatres having more than 200 cubic feet of air space for each person, or which have outside windows and doors, the area of which is equal to at least one-eighth of the floor area, shall be provided with artificial means of ventilation, which shall be in operation when the outside temperature requires the windows to be kept closed, and which shall supply during the time the audience is present, at least 500 cubic feet of fresh air per hour for each person. When the artificial ventilation is not in operation ventilation by means of open doors and windows shall be sufficient to provide each person with 500 cubic feet of fresh air per hour.

Motion picture theatres having more than 1,000 cubic feet of air space for each person and having outside windows and doors the area of which is equal to at least one-eighth of the total floor area, shall not be required to have artificial means of ventilation; provided the air is thoroughly changed by freely opening doors and windows immediately before the admission of the audience, and at least every four hours thereafter.

No part of the fresh air supply required by any of the above paragraphs of this section shall be taken from any source containing vitiated air.

The area of outside doors and windows shall mean the area capable of being freely opened to the outside air for ventilation purposes.

When fresh air is supplied by means of ventilating openings, at least one inlet shall be situated at one end of the room, and at least one outlet at the other end of the room. Where exhaust or inlet fans are necessary, at least one of such fans shall be placed in an outlet opening. The inlet opening or openings shall be placed in the floor or within 2 feet from the floor, and the outlet opening or openings in the ceiling or within 2 feet of the ceiling. The inlet openings and their surroundings shall be kept free from dust so that the incoming air shall not convey dust nor stir up dust as it enters.

During the time the audience is present, the air in the theatre shall be kept continuously in motion by means of fans to the number of at least 1 to every 150 persons. Such fans shall be placed in positions remote from the inlet and outlet openings. No person shall be exposed to any direct draft form any air inlet.

The booth in which the picture machine is operated shall be provided with an opening in its roof or upper part of its side walls, leading to the outdoor air. The vent flue shall have a minimum cross sectional area of 50 square inches and

shall be fireproof. When the booth is in use, there shall be a constant current of air passing outward thru said opening or vent flue at the rate of not less than 30 cubic feet per minute.

352f. Motion picture theatres must be kept clean and free from dust.

The floors, where covered with wood, tiles, stone, concrete, linoleum, or other washable material, shall be mopped or scrubbed with water or swept with moisture and soap, or water and some other solvent substance, at least once weekly.

Carpets, rugs and other fabric floor coverings shall be cleaned at least once daily by means of suction cleaning, beating or dustless sweeping. Curtains and draperies shall be cleaned at least once monthly by suction cleaning, beating or washing. Cornices, walls and other dust-holding places shall be kept free from dust by washing or moist wiping. The wood and metal parts of all seats shall be kept clean. Fabric upholstering of seats and railings and other fixed fabrics shall be cleaned by suction cleaning, or other dustless method, at least once monthly.

352g. Thru its Motion Picture Inspectors, as provided in subsection b of this ordinance, the Bureau of Licenses shall inspect, subject to the authority of the Mayor, the character of exhibitions in motion picture theatres, and shall report to the Mayor any offense against morality, decency or public welfare contained in said exhibitions.

352h. All provisions contained in this ordinance shall apply to existing places of entertainment where motion pictures are exhibited under a common show license, except those provisions of subsection d designated as Nos. 1, 2, 3, 4, 5 and 6, but the Bureau of Licenses shall have power in its discretion to enforce the provisions of said paragraph 3 of section d as to exits and courts.

352i. Existing places of entertainment seating 300 persons or less, where motion pictures are exhibited in conjunction with any other form of entertainment, must comply, before a reissuance of its license, with the provisions of section 109 of the Building Code, covering theatres seating more than 300 persons. But if such existing place of entertainment discontinue all other form of entertainment except the exhibition of motion pictures, it may be licensed in accordance with the provisions of subsection h.

352j. With the exception of paragraph 7 of subsection d, subsections a to f inclusive, and subsections h, i, k and l of this ordinance shall not apply to motion picture exhibitions with or without charge for admission, conducted under the direct management of educational or religious institutions, nor to motion picture exhibitions without charge for admission given or held not more than once a week in private residences or bona fide social, scientific, political or athletic clubs. Before motion pictures shall be exhibited in any of the places above mentioned, there shall be obtained from the Bureau of Licenses a permit for such exhibition. Before granting such permit, the Bureau of Licenses shall cause to be inspected the premises where such proposed exhibition will be held, and shall grant the permit if in its judgment the safety of the public be properly guarded, and provided that for an audience of more than 75 people all chairs or seats shall be securely fastened to the floor or fastened together in rows.

352k. The Bureau of Licenses at its direction shall specify the seating capacity for each open-air motion picture theatre. Aisles must be 4 feet wide, or wider, in the discretion of the Bureau or Licenses. At least two separate exits, remote from each other, shall be provided, and no exit shall be less than 5 feet in width. For every 25 persons to be accommodated in excess of 300, the total width of exits shall be increased one foot. All exits must be indicated by signs and red lights and the doors must open outwardly. Seats must be stationary, with backs 32 inches apart, and so arranged that no seat shall have more than seven seats intervening between it and an aisle. The floor must be constructed either of wood with sleepers or of concrete, and must extend at least 5 feet from the seats on all sides, provided, however, that in the discretion of the bureau of Licenses, a gravel floor may be substituted for wood or concrete. Chairs must either be securely fastened to wood or concrete floor or all chairs in a row must be fastened to one frame, except that where refreshments are served, tables and unattached chairs or benches used with them may be permitted.

352l. Only subsections a, b, c, d, paragraphs 7 and 13, and g, j and k of this ordinance shall apply to open air motion picture theatres.

352m. 1. It shall be unlawful for any person, firm or corporation to show or exhibit any motion pictures in any licensed place of public amusement, in any theatre, concert hall, motion picture theatre or in any open-air motion picture theatre without first having obtained a permit therefor issued by the Bureau of Licenses as herein provided. Every day's exhibition in any licensed place of public amusement without such permit therefor shall be deemed a distinct and separate violation of this ordinance.

2. The Bureau of Licenses shall not grant a permit to exhibit any motion picture until an application in writing shall have been made therefor to the Bureau of Licenses, nor until the plates,

films, rolls or other like apparatus by or from which such motion picture is shown or produced shall be inspected by a censor or censors duly authorized by the Department of Education from the teachers, examining or supervising staff thereof for the work of censoring motion pictures, nor until the motion picture itself shall be seen by the censor or censors, nor until a letter of approval from the Department of Education fully describing said motion picture shall have been received by the Bureau of Licenses.

In case such picture is approved by the Department of Education, the Bureau of Licenses shall issue a permit in writing and in such form as the Bureau of Licenses shall prescribe.

3. If any motion picture for the exhibition of which an application for such permit is made, is an obscene, indecent, immoral or impure motion picture which would tend to the corruption of the morals of youth or others, or if it pictures any crime, any murder, suicide, robbery, hold up, stabbing, assaulting, clubbing or beating of any human being in such detail as to offend the sense of morality or decency, it shall be the duty of the Bureau of Licenses to refuse such permit. Otherwise it shall be the duty of the Bureau of Licenses to grant such permit.

The Bureau of Licenses, however, shall not grant any such permit, unless it has received a letter of approval from the Board of Education, through its agents duly authorized for censoring motion pictures. In case any picture is declared by the censor or censors authorized by the Department of Education to be of such a high degree of educational, moral, spiritual, religious or sacred character as to make it in keeping with the highest ideals of the American Sunday as set forth in the laws of New York, the Bureau of Licenses shall indicate that fact upon the permit by the use of these words: "Approved for Sundays and week days."

Only such motion pictures as are thus approved by the Department of Education for Sunday use shall be used in such exhibitions of motion pictures as are permitted by law on Sunday.

4. In case the Bureau of Licenses shall refuse to issue such permit because of the failure to receive the aforesaid approval from the Department of Education, the applicant may appeal to the Mayor. Such appeal shall contain the statement of the grounds for the refusal of the Bureau of Licenses to grant a permit and shall be presented to the Mayor in the same manner as the original application to the Bureau of Licenses and shown and exhibited in the same manner as before the censors of the Department of Education. If any motion picture for the exhibition of which such appeal is made to the Mayor for permit is an obscene, indecent, immoral or impure motion which would tend to the corruption of the morals of youth or others, or if it pictures any crime, any murder, suicide, robbery, hold up, stabbing, assaulting, clubbing or beating of any human being in such detail as to offend the sense of morality or decency it shall he the duty of the Mayor to refuse such permit. Otherwise, after he has secured from the Board of Education a statement of the ground upon which a letter of approval was refused by the censor or censors duly authorized by said Board, it shall be the duty of the Mayor, in case he deems the decision of the Censors of the Board of Education to be erroneous, to grant such permit, and he shall direct the Bureau of Licenses to issue it as ordered by him.

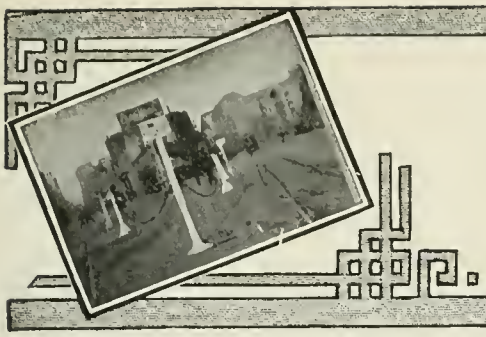
The determination of the Mayor in respect to the appeal for any such permit may be reviewed by writ of certiorari and the provisions of law and of practice in respect to the writ of certiorari to review the determination of an inferior tribunal shall be applicable thereto.

5. The permit provided for in this ordinance shall be obtained for each and every motion picture exhibited in any motion picture theatre, in any open-air motion picture theatre, in every licensed theatre or concert and every licensed place of public amusement, and shall be required in addition to any license now required by any other provision of this ordinance. No fee or tax of any kind whatsoever shall be charged or exacted for such permit.

6. When such permit to show or exhibit a motion picture is once issued to any applicant, such motion picture may be shown in any duly licensed place, provided that such written permit, clearly describing such motion picture is actually delivered to the licensee of such motion picture theatre or other licensed place of public amusement. Any number of transfers of such permit may be made, provided always that such permit is actually delivered to such transferee.

7. The permit provided for in this ordinance shall be posted at or near the entrance of the motion picture theatre or the open-air motion picture theatre or any licensed place of amusement where the motion picture permitted by such permit is being shown or exhibited at such a place and in such a position that such permit can easily be read by any person entering such theatre at any time when such motion is there being exhibited. The exhibition of any motion picture in any motion picture theatre or in any open-air motion picture theatre or any licensed place of public amusement without the posting of such permit therefor shall be considered a violation of this ordinance.

License fees for moving picture theatres are $100 a year and for open-air theatres, $50.



WORKERS IN THE FIELD

The Business Outlook

To the Editor MUNICIPAL ENGINEERING:

Sir—Your editorial in the June issue of MUNICIPAL ENGINEERING, on the "Business Outlook" impresses me as a somewhat optimistic interpretation or analysis of the present situation in business based upon a very broad view of the subject. The point of it seems to be that the present apathy in business is the result of a state of mind rather than of adverse legislation or incorrect administration of existing laws.

The present democratic administration went into office under the most favorable possible auspices. Public sentiment was strongly in favor of a change, and the apparently sound principles and inspiring promises of President Wilson commanded the respect and confidence of the public generally. The program of the administration has been mercilessly carried out and the public has waited patiently for the promised improvement. The reduction in tariff was said to be the most important remedy for the high cost of living and yet the year during which it has already been operative does not indicate even the slightest change in former conditions. The banking reform is generally regarded as a good movement but the proposed trust regulation and the apparent lack of proper attention to the railroad problem supply ample basis for the exercise of caution on the part of business men. It is not possible to foretell just how extensive may be the effect of the legislation still pending.

It is easy to try to console ourselves with the trite statement that business men are influenced by impulse and that poor business is fundamentally due to a state of mind, but one can not endorse such a sentiment without discrediting the intelligence of that great mass of men who operate and control the country's business activities. No one is more anxious to witness an improvement in business than the average business man. If a change in sentiment alone might accomplish this, the return of prosperity would not require a week nor a day. Business men are not so stubbornly opposed to good times as the President's recent expression indicates, and any such analysis of the situation is disappointingly academic.

S., Chicago.

The only argument against the spirit of optimism in the editorial referred to which has occurred to the writer, is one not mentioned by our correspondent. It is the fact that the trade depression is world-wide and is less in this country than elsewhere. But this argument supports the real point in the article, namely that if we will apply ourselves with the same energy to the development of the business in hand that we have heretofore in trying to promote new projects, we will not progress so rapidly, perhaps, but we will not be so apt to discount the future so much and will not need to stop production until the world catches up with our enthusiastic over-development.

Vancouver Garbage Collection and Disposal Ordinance and Methods

To the Editor MUNICIPAL ENGINEERING:

Sir—I notice in your last issue of MUNICIPAL ENGINEERING that you are asking your readers to supply you with any information in the matter of the collection and disposal of municipal wastes. As I was for a number of years in charge of the garbage department in this city, I thought that it might be of some use to the engineer who is making the inquiry, and also to the public as well, to describe our methods here.

The city of Vancouver has a population of 120,000 people and its area is about fifteen square miles. The layout of the city is such that there is an alley in almost every block. This, of course, makes the collection of refuse much cheaper than where everything has to be carried out to the front.

The city owns and operates all its equipment both for the collection and the disposal of all the city wastes.

Some years ago this work was being done by the contract system, but owing

to the unsatisfactory service being rendered to the citizens, the city council of that time very wisely put an end to the contract system, and placed the whole system under civic control. The city purchased the equipment which was owned by the contractor, for which they paid him a fair valuation, and by so doing acted fairly and justly with him. Under the contract system there was continual trouble between the contractor and the people to whom he was rendering the service. This might have been no fault of the contractor. The fault lay more with the city for having let the work out by contract, when they themselves should have kept it under their own control.

The city has now over 70 vehicles in the garbage department, consisting of single-horse carts, double teams, and large motor-trucks. The single carts are used mostly in collecting from the residential districts of the city, the large wagons in the collection of ashes and such like, while the motor-trucks are used in cleaning up the down-town district where the garbage and refuse is heavy.

The garbage is collected once per week in the residential districts, and every day from hotels and the business section of the city. The department will go to any part of the city when called upon, but the party ordering the vehicle has to pay for the charge, which is governed by by-law. From the residential section of the city there is no limit placed upon the amount of garbage that the city will remove, the only restrictions being, that the refuse must be placed in galvanized receptacles which must be kept covered and free from liquids. The garbage is removed free of cost from all residences and the cost is taken from the general revenue of the city. All business houses and such like have to pay the department for any services rendered, according to the amount of work performed.

This city has two destructors in which with an inspector in each district. These districts are subdivided into beats so that each teamster has his own beat to look after, and should any complaint come into the office, the inspector can at once find out who is at fault, as he knows the number of the man working on the beat at the time the complaint came in. The inspectors report daily to the head foreman, who has charge of the whole city under the superintendent. These reports are kept on file in the office for future reference.

There is no department in any city that can be run so smoothly that no trouble comes up, but the main thing that I found while in charge of this work, was to have a system that the cause for the complaint could be detected at once and the remedy immediately applied. Once the citizen sees that the department responds to any complaint, no matter how small, the public begin to place confidence in the department, and very shortly mole hills which would have grown to mountains will disappear altogether.

This city has two destructors in which all the wastes of the city are destroyed. The destructors have given good satisfaction and do their work effectively and without any nuisance. Both the destructors have steam boilers, but little or no use is made of the steam which is generated, the only use being the heating of the buildings and office around the plants. The calorific value of the garbage being low, would necessitate the purchasing of fuel in order to keep a steady supply of steam. With coal at $7 per ton this was considered out of the question.

Doctor Underhill, the medical officer, is a strong believer in the destruction of all city wastes by fire, and it was he who was the chief mover in getting the city to build the first destructor. During my term of office with the city I visited many of the cities in quest of information, after which I became more and more convinced that the doctor had formed the right opinion, in so far as this city was concerned. Each city has problems that belong only to itself, and a system that works well in one city may be of no use in another, consequently each city must be guided by conditions as they present themselves locally.

A clean city should be the pride of all good citizens, as the health of the community to a very large extent depends upon the cleanliness of each and every place within its confines, whether it be public or private property.

In order to get at the proper solution of the garbage problem, the cities must own and operate their own equipment. They must also be prepared to place men in charge who are thoroughly competent to run the department. Ward politics must cease to be the rnling factor in the selection. Then and not until then, can modern methods be adopted.

The system of direct charges for the removal of garbage is not a good one, and should not be resorted to. The operating expense should be charged to the general revenue of the city, or by way of tax levy against property. With the free collection of garbage there is no quibbling about the amount of refuse to be removed, which is always a bone of contention with direct charges.

I am enclosing you a copy of the by-law which governs the garbage depart-

ment in this city, the contents of which are to meet the conditions that exist in this locality.

P. Wylie,
Vancouver, B. C.

Following is the by-law or ordinance referred to:

By-Law Relating to Garbage and Ashes.

In this part unless the context otherwise requires:

"Dwelling" means any building or place, occupied or used as a dwelling, place of abode, or place of living, but does not mean or include any apartment house, tenement house, or building in which more than two families dwell, abide, or live, or which contains more than two separate places of dwelling, abode or living.

"Householder" means any person occupying or owning any dwelling, but shall not include any person who is merely a boarder, roomer, or lodger in such dwelling.

"Garbage" means any and all rejected, abandoned or discarded waste of household, vegetable or animal food, floor sweepings, tins, and bottles, crockery and glass or metal ware having contained food, and other household refuse matter (except ashes, as hereinafter defined) which can be destroyed or consumed by fire, and metal, tins, bottles, crockery and glass having contained food.

"Ashes" means ashes, cinders and the remains of any fuel after such fuel has been consumed by fire, and metal tins, bottles, crockery and glass not having contained food.

"Wagon" means any vehicle drawn by two horses, having a capacity of at least sixty-eight cubic feet.

"Cart" means any vehicle drawn by one horse and running on two wheels, having a capacity of at least thirty-four cubic feet.

Every householder shall provide and maintain in good sufficient order and repair for each dwelling owned or occupied by him, galvanized iron receptacles (circular in design), each of a capacity of two and one-half cubic feet, and each having a diameter of not more than sixteen inches, and a depth of not more than twenty-four inches, and each provided with a good, sufficient and watertight cover, sufficient, in number to contain all garbage and ashes from such dwelling.

A sufficient number of such receptacles shall, at all times be so kept by such householder, and maintained for garbage and for nothing else, and a sufficient number of such receptacles shall at all times be kept and maintained by such householder for ashes and nothing else.

Such receptacles shall at all times be kept on the premises of or connected with such dwelling and shall at no time be kept or put or encroached upon or project over any street, lane, or public place.

Such receptacles shall, at all times, be kept on a portion of the premises of or connected with such dwelling immediately adjoining a lane, if there be such a lane, and from such lane there shall be provided a gate, door or entrance, of such size and kind as to permit of ready access to such receptacle.

Where there is such a lane, such receptacle shall, at all times, be kept and maintained at such gate, door or entrance, and such gate, door or entrance shall be kept unlocked or unfastened at all times, necessary to allow any employee of the City to obtain access to such receptacles for the purpose of emptying same, and such householder at all times shall permit and allow any such employees to have access to and to empty such receptacles.

Such receptacles shall, in all cases, be at all times kept on the ground level and be so placed as to enable any such employee to empty the same. In case such receptacles are enclosed in any separate shed or housing, then such shed or housing, if there be a lane, shall be built flush with the lane and have doors opening outward upon the lane, whereby the receptacles may be emptied from the lane, and have a lift door inside such premises thru which garbage or ashes may be deposited in such receptacles. In case there is no such lane, and in case such receptacles are enclosed in any separate shed or housing, then such shed or housing shall have doors opening from some side thereof whereby the receptacles may be emptied, and a lift door at the top thru which garbage or ashes may be deposited, and in case there is no such lane, at all times a passage-way and ready means of access to such receptacles shall be provided from the street, and such passage-way and means of access shall be unobstructed and of sufficient size and kind to enable any employee of the City to carry any such receptacle thru same to the street.

Every householder shall deposit all garbage of and from his dwelling in the receptacles hereinbefore required to be provided for same, and shall deposit all ashes of and from his dwelling in the receptacles hereinbefore required to be provided for same.

Notwithstanding anything hereinbefore set out, in the case of dwellings the ashes or garbage of or from which shall amount to more than twenty cubic feet per week, the receptacle or receptacles for such ashes or garbage may be of such other shape, nature, capacity and design, and shall be placed and located in such

places as the City Engineer of the City shall, on application made to him, approve and designate. But otherwise all the provisions of this part shall apply to the case of any such dwelling.

No charge shall be made by the City for taking up, collecting and conveying away any garbage or ashes of any householder from any dwelling as defined by this part, provided that such householder shall have complied with the preceding provisions of this part.

No liquids or free water shall be put or placed in, or allowed to run into, or accumulate in any receptacle for garbage or ashes, and all such receptacles shall at all times be kept securely covered with a water-tight cover.

Except as otherwise in this By-law, or any other By-law of the city provided, every person shall at least once every seven days remove or cause to be removed all garbage and ashes of or from all premises owner or occupied by him, and destroy, or cause to be destroyed, such garbage or ashes either at the city incinerator or outside the limits of the city.

Every person having any scavenging work (other than that for which the charges are hereinbefore specified) or cremating work done by the city shall pay the following fees and charges:

(1) For hauling garbage and ashes:

Per wagon load, one mile or under	$2.50
Per every additional mile or portion of mile	.50
For packing out wagon load	1.00
For cart load, one mile or under	1.25
For every additional mile or portion of mile	.25
For packing out and picking up, per cart load	.50
For packing out and picking up dogs	.50
For packing out and picking up cats	.50

(2) Lessees, owners, or occupiers of any place of business, or buildings other than dwelling houses, desirous of contracting for less than one cart load, shall pay for the removal of garbage and ashes at the rate:

For 3½ cubic feet or less	.12½
For packing out same on the ground floor additional charge for each 3½ cubic feet or less	.02½

(3) Where no contract has been entered into with the city the following prices shall be paid:

For 3½ cubic feet or less	.15
For packing out same, additional charge for each 3½ cubic feet or less	.05

(4) No garbage shall in any case be removed by the Scavenging Department of the city to the incinerator unless the same is placed so that it is free and unmixed with ashes or other non-combustible material, and unless the same is free from liquids.

(5) Prices for Cremating.

Horses, aged and under aged	$3.00
Cows, aged and under aged	3.00
Calves, pigs, sheep and goats	.75
Dogs	1.00
Decayed fruit and vegetables, per 100 lbs.	.25
Condemned fish, per 100 lbs	.20
Fish offal, per 100 lbs	.20
Slaughter house offal, per 100 lbs	.20
Condemned meat, per 100 lbs	.20
Rotten eggs with cases, per 100 lbs	.50
Condemned milk or cream, per 100 lbs.	.30
Refuse (including boxes and crates not exceeding 2 ft. by 2 ft. by 3 ft.), per 100 lbs	.05
Refuse, with boxes exceeding 2 ft. by 2 ft., per 100 lbs	.15
Paper-bound records, per 100 lbs	.10

The Scavenging Department will not accept at incinerator loads containing anything except garbage as defined by this part, or combustible matter.

Any cart, wagon or other vehicle used or intended to be used for the purpose of conveying swill, offal or garbage, shall be and be kept covered, and shall be and be kept perfectly tight and covered so as to prevent the contents thereof from leaking or spilling, and shall be of such pattern and description as may from time to time be approved by the Medical Health Officer, and no such cart, wagon or other vehicle when not in use shall be allowed to stand in any highway, street, lane, alley, public place or square.

All householders and persons shall comply in all respects with the provisions of this part, and any person who fails to comply in any respect with the provisions of this part or any of them, shall be guilty of an infraction of this By-law, and subject to the penalties thereof.

Nothing in this part contained shall relieve any person from complying with the provisions (where they are applicable) of any other part of this By-law, or with the provisions (where they are applicable) of any other By-law of the City.

Form of Report of Work Done in City Street and Sewer Repair and Maintenance

I present you herewith a form of daily report for the assistant street superintendent, which is intended to keep the various work done in this department properly classified as well as to show unit

costs and also serve as a check against the pay roll and expenditures made by this department.

It might prove of interest to other cities of about the size of this city, which has a population of about 12,000.

C. L. CONDER, Corporation Counsel,
Pekin, Ill.

DAILY REPORT

ASSISTANT SUPERINTENDENT OF STREETS

DEPARTMENT OF STREETS AND PUBLIC IMPROVEMENTS

_____ 191___

I. PAVED STREETS*

(A) **Name of Street Cleaned**

Where Cleaned

Refuse—Nature of and how disposed

Remarks

(B) **Streets Repaired**

Nature of Repairs

Where

Remarks

(C) **Miscellaneous Street Work**

Where

Nature

Remarks

*If Alleys, so Indicate with an X

PERMITS	INSPECTED AFTER RESTORATION
For What	Where
Where	To Whom Issued
To Whom	Condition at Time Inspected
How Long	

GENERAL REMARKS

II. UNPAVED STREETS*

Name of Streets

Where Located

Nature of Work

Remarks

*If Alleys, so Indicate with an X

PERMITS	INSPECTED AFTER RESTORATION
For What	Where
Where	To Whom Issued
To Whom	Condition at Time Inspected
How Long	

	Number Men Employed	No. Teams	No. Sq. Yds. Done	No. Loads Refuse	No. Cubic Yards	Length of Haul	No. Hours Worked	No. Hours Teams	Labor Cost	Team Cost	Miscellaneous Cost	TOTAL COST
(Paved Streets) A												
B												
C												
(Unpaved Streets) II												

III. CURBING

(A) Where Placed (New)

Kind, State whether done by Contract or Day Labor

Size

(B) Name of Streets Curbing Repaired

How Repaired

Remarks

	Contract Price per Linear Ft.	Quantity Laid	Specifications	Cubic Ft Sand	Cement	Cubic Ft Gravel or Stone	Cost Sand	Cost Cement	Cost Gravel or Stone	Team Cost	Labor Cost	TOTAL COST
A												
B												

IV. Crosswalks

(A) Where Placed

Kind, State whether done by Contract or Day Labor

Size

(B) Name of Streets Cross Walks Repaired

How Repaired

	Contract Price per Linear Ft.	Quantity Laid	Specifications	Cubic Ft. Sand	Cement	Cubic Ft. Gravel or Stone	Cost Sand	Cost Cement	Cost Gravel or Stone	Team Cost	Labor Cost	TOTAL COST	
A													
B													

V. Sidewalks

(A) Where Placed

Kind, State whether done by Contract or Day Labor

Size

(B) Name of Streets Sidewalks Repaired

How Repaired

Remarks

	Contract Price per Square Ft.	Quantity Laid	Specifications	Cubic Ft. Sand	Cement	Cubic Ft Gravel or Stone	Cost Sand	Cost Cement	Cost Gravel or Stone	Team Cost	Labor Cost	TOTAL COST	
A													
B													

VI. Sewers

(A) Where Cleaned

How Cleaned

(B) Repaired, How and Where

(C) New Sewers Built, Where, Kind

Remarks

	No Catch Basins Cleaned	Number Men Employed	Number Teams	Loads Silt Removed	Cu. Yds Silt Removed	Amount Work Done	Sewer Tile Used	Labor Cost	Team Cost	Material Cost	Miscellaneous Cost	TOTAL COST	
A													
B													
C													

VII. City Teams

Number Horses	Number* Wagons	Tons Hay	Tons Straw	Bushels Oats	Bushels Corn	Number Teamsters	Cost Hay	Cost Straw	Cost Oats	Cost Corn	Labor Cost	Cost Shoeing	Repair Cost	TOTAL COST	

*If Other Implements Used, Indicate.

Grand Total, $ .....

Signed .....

Assistant Supt. of Streets

July, 191

Who Supplies Novaculite?

To the Editor MUNICIPAL ENGINEERING:

Sir—I note the inquiry in the June number of MUNICIPAL ENGINEERING and this is to advise that the Novaculite Paving Company has its office in the Victoria Building, Eighth and Locust Sts., St. Louis, Missouri. Its quarry is at Tamms, this county.

This city has used much of this product in the past and will shortly advertise for Paving District No. 1, and all the paving in said District will be Novaculite.

ROBT. A. HATCHER,
City Clerk, Cairo, Ill.

Voids in Crushed Stone

C. A. Baughman, of the Iowa State College Engineering Experiment Station, Ames, Iowa, refers W., whose question is printed on p. 544 of the June number of MUNICIPAL ENGINEERING, to Bulletin 23 of the Engineering Experiment Station of the University of Illinois, Urbana, Ill., for information concerning the voids in crushed stone.

Bulletin 23, by Ira O. Baker, was published in 1908, and gives details of methods and results of tests on Joliet, Chester and Kankakee, all Illinois limestones, considering specific gravity, absorptive power, and percentage of voids Voids were determined from specific gravity and by pouring in water, on various sizes of stone placed in various sizes of vessels, with various heights of drop into the vessels. Settlement of crushed stone in transit in cars and in wagons, and the weight per cubic yard were also studied thoroughly, as well as the relations between weights of crushed and solid stone. An appendix gives some results for weight and voids of crushed trap rock.

Following are some of the average results:

Size of Stone.	Percentage of Voids.
¾-in. screenings	39.6 to 46.8
½-in. screenings	42.2 to 47.1
¾-in. screenings	43.0 to 45.6
1¼-in. to ¾-in. screenings	42.2 to 45.7
2 -in. to ½-in. screenings	46.2 to 47.9
2 -in. to ¾-in. screenings	46.6
2¼-in. to ⅜-in. screenings	42.9 to 44.3
2¼-in to 1¼-in. screenings	43.4 to 46.2
3 -in. to 2 -in. screenings	45.1 to 47.5

There are opportunities for variation in results, because of use of two methods of determining voids, three kinds of stone, six sizes of vessels used in the experiments, five different drops of stone into vessel, from shoveling in to 20 feet drop, different observers, etc. The individual results give somewhat greater ranges than the averages quoted.

With each size of vessel used the voids increase with the size of the stone. Voids are materially less with 20-foot drop into vessel than when simply shoveled in. For large stone the difference between the methods of determining voids is practically nothing, but with smaller sizes the method by pouring in water gives considerably smaller percentage of voids than computation from specific gravity.

Conscience in Municipal Engineering

To the Editor MUNICIPAL ENGINEERING:

Sir—Conscience may be defined as an inherited tendency towards righteousness. It may remain dormant, but, fortunately, the majority of the individuals who constitute the "mass of humanity," possess this potential righteousness, and its awakening at some period during the career of the individual is probable.

The awakening of conscience is betokened by the assumption, the introduction and the subsequent practice, with more or less consistency, of a code of morals. This code is, however, practiced in two distinct manners. The majority are content to practice it conservatively and at home, avoiding carefully all temptation to violate it and succeeding admirably in adhering to well formulated principles without in the least disturbing the equanimity of their less moral neighbors and without, in any way, entering into the general conflict against the common evils which confront the race. Those of the other class, still in the minority, unfortunately, practice their codes openly, aggressively and with initiative. These are the leaders in the movements toward betterment in all walks of life and the achievements of a number of them whose activities are directed towards the public welfare, in what is commonly known as civic betterment, are of vast importance to the progress of civilization.

Coming to the point, we may take New York as the scene of the strife for civic betterment and may consider the municipal engineer in his attitude towards it. One does not have to delve into remote history to reveal this person in the guise of a moral tadpole. It is within the memory of living man, when he wiggled about in the pool of civic stagnation, hoping for the day when, as an active moral frog, he might jump to the bank and view the sunlight. The day has arrived and while the sunlight may, perhaps, at times, be obscured by a passing cloud, it is true that the tadpoles are developing hourly and are emerging in new form from the depths of the dark pool. Having seen the sunlight, it is the impulse of those whose lot

has been cast in the pool, to go back and clarify it.

We are thus daily increasing the numbers of those who are aggressively following their code of morals. We are passing the time in which we were content to tolerate on the part of others what we considered improper for ourselves. We are unwilling to yield to those who will not see the sunlight and we are going to bring them into it or destroy them.

The latter day practice in municipal engineering has developed with some and has been forced upon others on the theory that each man must show his hand, he must work in the open, and the barrier of mystery in which the incompetent surrounded himself to conceal his incompetence, and with which the competent surrounded himself for protection against the incompetent, is destroyed. The "one-man policy" in which the person in a position of advantage acquires and holds information essential to the proper conduct of a piece of work, thereby making himself indispensable, is becoming obsolete. Engineers find that their positions are more secure and more important when they are understood than when their work is shrouded in mystery. It is no longer expedient to cover one's tracks in order to conceal possible errors. It is far more profitable to acknowledge and correct them. The executive engineer who exposes and reports his own mistakes as well as those of his subordinates gains the confidence of his superior officers and the respect of his subordinates. If his mistakes are too numerous to be tolerated, the old style concealment will not avail, for, as it has been said, the new idea is being forced upon those who do not adopt it voluntarily.

It frequently happens that specifications are incomplete, that some item of importance is omitted, or that some unexpected obstacle is encountered in the execution of the work which the contractor refuses to correct or overcome, without extra compensation. It has been known that such difficulties have been adjusted by an arrangement between the engineer and contractor, whereby the latter would be released from some less important obligation in compensation for his performance of the additional work. While these bargains were almost invariably made on the "dollar for dollar" basis and were usually of benefit to the work, it is within the scope of imagination to conceive of cases in which the exchange was not equitable and in which the bargain was made rather to conceal errors than to correct them. When, however, the work must be publicly reported in detail, or when the work is executed by an engineer who is beyond the control of the one who drew the specifications, the latter is required for his own protection to develop more carefully the details of his work so that corrections in the field will not be neecssary.

Another abuse which has been abated by publicity is the ancient system of continuing work until the appropriation, far too large originally, became exhausted. It has happened that work has been extended and modified repeatedly until the ultimate creation was far in advance of the original and the funds still showed a balance. The process was similar to the plan pursued by the suburban homesteader who purchases a gallon of paint to cover the kitchen porch and finding a large balance on hand after having completed it, proceeds to paint the back fence and the barn doors. With specific appropriations based upon itemized estimates, carefully analyzed, there is no balance remaining after the completion of the work, and therefore its indefinite extension is not possible. Again the preparation of the specification and the estimate must be more careful for "extras" cannot be met within the appropriation.

There is another phase of municipal work which has undergone a change in recent years, and that is the relation between the executive engineer and his subordinate. The former is rapidly realizing that the errors of the latter will be revealed in the day to day "exposures." It is unprofitable to protect an incompetent subordinate for political or personal reasons, because the incompetence of the subordinate will be accredited to the superior who attempts to conceal or correct poor work.

Ability is a comparative term and it fails to express all the qualifications which the latter day engineer must possess. Yesterday a man was judged alone on his ability and promptness. Today he must be capable, prompt and efficient. We have a new dimension to consider, the unit of which is the American dollar. In order to measure up to the new standard, a man must possess all three dimensions, the product of which is competence. The new idea then of competence includes ability, which is largely built on experience, it includes promptness which means energy, and it includes efficiency which means study. To be efficient one must recognize the errors made by himself and others and studiously avoid both. Someone has said that efficiency is common sense; it is more than common sense, it is insight.

The improved definition of competence, as set forth above, is today the test which every engineer must meet. He may possess one of the elements in larger measure than the other two, but he must possess some amount of all three and the executive engineer must possess even more than this newer competence; he must possess conscience, the active ag-

gressive kind of conscience which influences other men. He must be one of the frogs already on the bank, one of the fellows who have seen the sunlight.

Again, he must possess courage, for conscience without courage is not a valuable asset. He must possess courage which will prompt him to go back into the pool and clean it. Taking then this alliterative trio, competence, conscience and courage as basic ingredients, we may mold a man of worth as an engineering executive.

The optimist believes that such men are already with us, men possessing the basic principles of leadership, and he believes there are a few who also occasionally reveal higher human attributes even than these, such as sympathy, fellowship and kindness, all of which are defined as consideration and all of which result, or at any rate develop from association with wholesome and cultured beings. As time advances, there will be more engineers, civic and private, who possess competence, conscience, courage and consideration.

Alfred Williamson, Mechanical Engineer, Department of Water Supply, Gas and Electricity, New York City.

Boston Well Supplied With Rapid Transit Facilities

In the opinion of the Boston Transit Commission, of which George F. Swain is chairman, the business section of Boston covers a comparatively small area, and within this area there is apparently already provided a greater mileage of subway and elevated lines than in any equal area in any American or foreign city, with the possible exception of London and New York. The area of the peninsula of Boston, bounded by the Charles river, the harbor, Fort Point channel, Dover and Berkeley streets, is only about 1.80 square miles. Within this area there are already in operation, or under construction, about 9.05 miles of subway and elevated lines, with about 19.7 miles of single track. If the area were square, this mileage would provide for double track rapid transit lines crossing it in each direction at intervals only about 1,800 feet apart. Taking the actual shape of the area, there is no part of the business district east of Beacon Hill, which is more than about 1,100 feet distant from some rapid transit line. The distance from the Washington Street Tunnel, a thru line north and south, to Atlantic avenue at the head of docks along the harbor on the east is about 2,000 feet. There are three north and south rapid transit lines thru this district, namely: the Tremont Street Subway, the Washington Street Tunnel and the Atlantic Avenue elevated line, and the distance between adjacent lines is nowhere more than about 2,200 feet; and there are two rapid transit lines east and west through the district, namely, the East Boston Tunnel and the Dorchester Tunnel and these are nowhere more than about 2,800 feet apart.

It is thus evident that the business section of Boston is already well provided with underground and overhead rapid transit lines; and by transfer it is possible to reach any point on any one of these lines, going in the same general direction, for a single fare.

These figures will perhaps illustrate the character of the facilities which have already been provided, and will show the need of exercising great caution before advising the construction of another underground line in this limited district at the present time.

Burned Asphalt Cement Can Be Prevented

Few contractors realize the seriousness of burned asphalt cement and the amount of money lost through this cause. Pavements crumble away and yet hardly any attention is paid to this particular cause of their crumbling. Hardly any contractor would risk using hydraulic cement in his concrete that he knew had been spoiled, because common sense would tell him that he might have to take all the concrete up again, and yet he seldom stops to think that his asphalt cement may have been burned and therefore spoiled, and that he may have to take up his course of top and binder as a consequence. Experience has proved that when steam at a pressure of 125 pounds and without superheat is used in coils placed across the kettles, the asphalt cannot exceed 350° F. and in kettles properly constructed for the purpose, the heating of a large mass of asphalt takes much less time by this means than with furnace heat applied to the exterior of the kettle at a temperature of at least 1200° F. Also, no burning takes place; whereas, in the case of furnace heat at 1200° F. all asphalt coming in contact with the part of the kettle nearest the furnace is burned in spite of any agitation given it. Where furnace heat is used, the vital operation of heating the asphalt cement generally depends upon the intelligence of a $3.50 per night colored man. He, as a rule, is no more conscientious than an average hired laborer, and as the superintendent cannot work 24 hours every day and watch the night work as well, takes frequent advantage by sleeping during the night and then firing very heavily towards morning to have the A. C. hot enough for the morning. This cannot occur with steam heat. It has also been proved that steam heat

is more easily regulated and the resultant penetrations have been more regular as a consequence.

Asphalt manufacturers are adopting steam heat more and more every day as they realize the danger of furnace heated kettles spoiling their products.

Buckling of New Brick Pavement at Elmira, N. Y.

To the Editor MUNICIPAL ENGINEERING:

Sir—A valuable lesson in brick paving construction was afforded at Elmira, N. Y., on June 10 when a section of a new brick pavement buckled, due to the intense heat of the sun.

Regardless of the sun's heat or any other weather condition, this pavement, in the opinion of experienced pavement engineers, would not have buckled had it been equipped with transverse expansion joints.

The pavement on which this buckle occurred was built late last fall. It extends a distance of 1940 feet on West Church street, from Hoffman street west of Guinnip avenue, and is one of a series of connecting links to the New York State highways now under construction in the southern section of the state.

The firm of Holleran Brothers, Elmira contractors, built the pavement under the direct supervision of the state highway department. The specifications were followed out to the letter and the pavement was declared one of the best built in this section of the state.

The State Highway Department, however, did not deem it necessary to include transverse expansion joints in the specifications for this pavement and, of course, they were not put in.

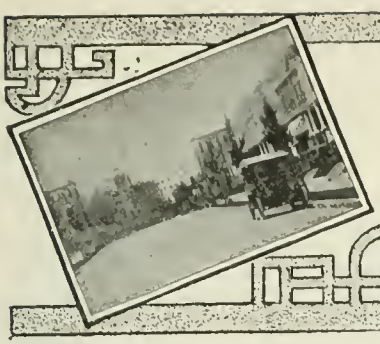
On the afternoon of June 10 there was a loud report, which came from underneath the bricks at the corner of Foster avenue and Church street. Almost simultaneously the pavement heaved and buckled in a mound nearly the entire width of the street as the accompanying illustrations show.

City Engineer Brown and Resident State Engineer Child, after an inspection of the buckle, found that the foundation had not been injured in the least. The heat of the sun had caused the bricks to expand and buckle. They declared the accident would not have occurred had transverse expansion joints been put in when the pavement was built.

As a result steps have been taken to place expansion joints in other state pavements now under construction in this city and vicinity.

JOHN T. CALKINS.

BUCKLING *of new brick pavement in Elmira, on Church street, at intersection with Foster avenue.*



ROADS AND PAVEMENTS

Empirical Requirements in Asphalt Specifications

By Leroy M. Law, Chemist of the United States Asphalt Refining Company, Baltimore, Md.

In many of the early types of specifications we have seen such requirements as "The material must be A. B. C. brand or equal thereto" and "The material shall have given satisfactory service under similar conditions for such a period of time." Such conditions especially unfair to the manufacturer are rapidly disappearing, yet today in many of the so-called scientific specifications, the adoption of requirements based on arbitrary methods of analysis has placed the honest producer in an equally uncertain and embarrassing position. It is to three such such requirements which have gained and still hold surprising popularity in many current bituminous specifications that I now invite your attention.

The first stipulation of this character to be mentioned is that limiting the so-called "fixed carbon," and it is indeed difficult to understand just how this requirement ever secured a foothold in asphalt specifications.

Fixed carbon is a test stolen from fuel chemistry, where it serves to indicate the coke remaining after the gaseous constituents have been removed by heating the material, with exclusion of air, under prescribed conditions. Those who have had any experience in fuel work whatever know full well that this test is purely empirical and that the variations among different operators, especially in different laboratories, is often considerable, and that this method is not applicable even to some fuels. How much more inapplicable then will the method be to softer materials like the asphalts and road oils, which have also the disagreeable tendency of foaming out of the crucible at certain stages of the heating?

Difference in gas used in heating and in polishing of crucible introduce errors.

If the wide variations shown in tests occur with coals what, then, should we expect when the method is applied to soft asphalts and even oils?

As a chemist of one of the large asphalt companies, I have observed this fixed carbon requirement enforced to extremes and yet to no purpose or benefit to the consumer. The yield of fixed carbon can not be controlled in the process of manufacture, unless thru gross carelessness in coking material. In this case, the defects will be shown far more accurately by increased insoluble matter in the various reagents employed in bitumen analysis.

Some weeks ago the writer prepared two samples of bituminous material of different consistencies, dividing each sample into several portions. These were sent to several laboratories to make the fixed carbon tests. The operators selected were not those of the usual commercial laboratories, but chemists who are especially qualified and equipped for asphalt work, and regarded as our foremost experts in this branch of the profession. The tabulated results of their work are shown in the accompanying table.

Results of Fixed Carbon (Percentages).

Sample No.	213	215
Laboratory A	12.00	17.4
Laboratory B	13.62	16.85
Laboratory C	10.91	13.13
Laboratory D	12.52	17.54
Laboratory E	12.63	17.20
Laboratory F	17.10	22.00

Inspection of the figures shows a variation in fixed carbon on the same samples of over 6 per cent. in one case and nearly 9 per cent. in the other. When experienced operators such as the above differ by these amounts on identical samples, is there any wonder that with chemists generally the variations are even greater? It is to be regretted that chemists do not study the value of these tests before incorporating them in their specifications and extend to good materials and their honest manufacturers a just consideration.

Some days back it was our misfortune to have a shipment of asphalt rejected, because the fixed carbon as determined

in the customer's laboratory ran from one-tenth to three-tenths in excess of the prescribed limit. I had previously tested the batch from which this shipment was made, and found the fixed carbon considerably below the requirements of the specifications. An absurd feature of the case is that another carload from the same batch was accepted as meeting the requirements, the inspecting chemist, doubtless, being unconscious of the variation he was experiencing in his own laboratory.

But I leave the subject of fixed carbon to pass to another empirical requirement of still greater uncertainty; i. e., the so-called paraffin determination.

This procedure is supposed to show the amount of hard or "scale" paraffin present in the material and is, therefore, considered to be an index as to its liability to crack in cold weather or granulate with age. The general procedure employed in this determination is doubtless familiar, consisting of distilling the material rapidly down to dry coke and collecting the distillate. The latter is then weighed, an aliquot portion removed, dissolved in alcohol-ether, chilled and the crystallized scale filtered off, dried and weighed. Many specifications prescribe that the scale shall not exceed a certain figure, yet few of them prescribe their modifications in detail. The results are that each customer performs the test in the manner most agreeable or convenient to himself, and the manufacturer has to stand for the whims and modifications introduced.

In an effort to learn something as to the paraffin test as generally applied, the six laboratories who replied to the fixed carbon inquiry were also asked to determine paraffin scale in the same samples. They did so with the exception of one laboratory, which, for reasons not stated, declined to make the determinations. I trust that laboratory E realizes the unscientific status of the paraffin scale test and it was this realization that prompted them to decline to report on the subject.

Results on Paraffin Scale (Percentage).

Sample No.	213	215
Laboratory A	3.6	2.8
Laboratory B	0.10*	1.58
Laboratory C	2.7	1.49
Laboratory D	1.21	1.25
Laboratory E	....	....
Laboratory F	4.13	3.04

*Material foamed considerably. Analyst is of opinion that there is no accurate method and results are only approximate.

The above results tend to make a laughing stock of the profession and are printed only with the hope that asphalt chemists may soon get together and study or eliminate these embarrassing subjects.

Our company is furnishing a certain material to one customer who limits paraffin to 1 per cent. From him we have had no complaint whatever, yet the same material is ineligible under another specification, having been reported to contain paraffin in excess of 4 per cent. I ask you candidly which chemist is right, and what is the manufacturer to do under such conflicting evidence?

Turning now to a third requirement of questionable scientific value, and non-indicative of either quality or service results, I call attention to a requirement in many road oils and binder specifications which states that the material at, say, 50 penetration, shall have a specified minimum ductility. The idea is that the bitumen shall possess adhesiveness, a quality best shown by the ductility test and by concentrating to 50 penetration, the standard consistency for this ductility test, all materials are brought to a uniform basis of comparison.

Thus far, the idea is sound but the method of concentration, the all-important feature, is sadly and ignorantly neglected. Some chemists in a blind attempt at conserving ductility, stipulate that during concentration, the temperature shall not exceed, say 400 or 500 degrees F. Others provide for "occasional" stirring, but generally they neglect the essential feature in asphalt treatment, namely, the agitation. In hardening the softer asphalts, agitation plays, if anything, a far more important role toward conserving ductility than does the mere restriction of temperatures. My interviews with inspecting chemists relative to this test, show that they are uniform only in following "no regular procedure."

Some of them use heat test residues which by accident have just reached 50 penetration, or again this residue treated to a further heating on a hot plate or in an oven to obtain the desired consistency. Others concentrate the material from an oily state to asphaltic consistency in a single operation, either on a hot plate or in an oven, with or without agitation, as suits their fancy, and the manufacturer must ascertain and duplicate in his laboratory all of these eccentricities to find out the chance his material has of passing a so-called scientific specification.

On one occasion the writer submitted to a prospective customer a series of asphalt products and asphalt cement. These were tested by the inspecting chemist who passed the harder materials, but rejected the softer ones, as absolutely lacking in ductility when reduced to 50 penetration.

The chemist allowed me to look over his results, and I observed that with the material requiring the least concentrations he had secured the highest ductility and in case of the fluid material, requir-

ing the greatest concentration to reduce it to 50 penetration, practically no ductility was obtained. All of the products were from the same primary material, the maltha, the harder ones being produced by refinery operations which neither he nor anyone else could duplicate in the evaporation tins of the asphalt laboratory.

In the instance cited, the chemist's process was undoubtedly one destructive to ductility, for the longer the heating required to reach 50 penetration the lower the ductility of the product. The individual in question avoided the issue by deciding that to his mind the test represented service conditions where no agitation of the material took place.

Such clauses as fixed carbon, paraffin scale, etc., in their present empirical state and coupled with a narrow and rigid interpretation are not only a discredit to the profession, but destroy the value of a sincere specification.

It has just been stated that the principal object of the specification is to lay before the manufacturer in a clear, concise manner the requirements that are to be met. When he is unable to interpret these with a reasonable and standard equipment, the purpose of the specification fails.

The rapid development in bituminous highway work during recent years has been accompanied by an accumulation of inspection methods, desirable and questionable ones springing up together, and the many young chemists in this field of work doubtless look upon them as methods of established, scientific value. Other chemists with only time for routine work of testing become advocates of such requirements as they might otherwise suppress. Furthermore specifications of one city or municipality are frequently copied from those of another, which presumably from a longer experience in bituminous work is looked upon as a criterion in such matters.

And so by these and other unstudied procedures our asphalt specifications have been brought to this present empirical condition, and the time is at hand for chemists in this branch of the science to co-operate in weeding out the tangled field of laboratory methods.

No one chemist should, and no true scientist will, decide that check results in his own laboratory establish the reliability of a test or method of analysis. Such is at least to be expected. A true scientist will endeavor to ascertain what the procedure shows in the hands of others, presuming, of course, average qualifications in experience and skill.

If as a result of such study fixed carbon, paraffin, etc., are found to be of value, then it will be of interest to all concerned to adopt definite procedures and agree on the limitations of accuracy. If they cannot be developed into real scientific methods, capable of yielding concordant results in the hands of all qualified chemists, then they should, by mutual consent, be abandoned. In their present empirical condition they can not be of any possible assistance in determining the quality or even the uniformity of a product, but on the other hand, their employment frequently works injustice to valuable materials.

Variations from the Standard Asphalt Specifications

The points in Mr. Law's article above are emphasized by some recent specifications. Two of these are selected for consideration here because they are so nearly opposite in the results obtained in the selection of asphalts for use.

One of these is the specification adopted by City Engineer George C. Powell, of Toronto, Ont., for the purchase of asphalt for the municipal asphalt plant. Following are some of the provisions of these specifications:

All asphalt herein shall be obtained by heating crude natural asphalt or crude asphaltic petroleum without the admixture of any other material to a temperature of 400 degrees F. until all the water and light oils have been driven off, and the refined asphalt thus obtained must meet the following requirements, viz.:

(1) It shall contain not less than 90 per cent. of bitumen.

(2) Not less than 98.5 per cent. of its bitumen shall be soluble in carbon tetrachloride at air temperature.

(3) Not less than 65 per cent. of its bitumen shall be soluble in standard petroleum naphtha at air temperature, and the word "bitumen," as used in these specifications, shall signify and shall be taken to mean "any hydrocarbon, or hydrocarbons, soluble in carbon bisulphide at air temperature.

(4) It shall not contain more than 15 per cent. of fixed carbon on ignition.

(5) Fifty grams of refined asphalt, when heated in an open flat-bottom cylindrical dish, 2⅞ inches in diameter and 1¼ inches high, shall not lose more than 5 per cent. of matter by volatilization at 325 degrees F. in twenty-four hours.

(6) It shall not be softer than sixty penetration at 77 degrees F. (Dow machine).

(7) It shall not be harder than that which will require more than 15 per cent. of flux, calculated on the percentage of bitumen, to produce an asphaltic cement of forty-five penetration at 77 degrees F.

(8) The flux used in the preparation of the asphaltic cement above mentioned will be any suitable standard flux having

a specific gravity at 60 degrees F. between 0.9395 and 0.9722.

(9) All asphalt herein shall be subject to the approval of the commissioner of works and be tested at destination.

One expert states that with the exception of the fixed carbon test these specifications will admit practically every asphalt with the exception of Trinidad or Cuban or other materials which do not contain more than 90 per cent. bitumen.

The controversy at Toronto has been based upon the fixed carbon requirements of not more than 15 per cent. This makes it very difficult for the Mexican people to supply their material, as they are very apt to run higher than 15 per cent.

Another expert arrives at almost exactly the same conclusions.

The city engineer of Indianapolis, Ind., B. J. T. Jeup, has recently let contracts under a new specification, the first paragraphs of which read as follows:

The refined asphalts for sheet asphalt pavements shall be either Trinidad Lake, Cubanel, Texaco, Bermudez Lake, Mexican or California. These asphalts are divided into three grades and contractors shall submit bids stating grade or grades of asphalt bid upon.

First Grade—Trinidad Lake refined asphalt.

Second Grade—Cubanel and Texaco refined asphalts.

Third Grade—Bermudez Lake, Mexican and California refined asphalts.

The asphalts and asphaltic cement shall conform to the following specifications.

Then follow special specifications for each of the asphalts above named and for the asphaltic cements made from each and the fluxing material.

The city had previously purchased asphalt for the municipal repair plant on a more general specification, securing asphalt of what is above termed first grade.

Both the Association for Standardizing Paving Specifications and the American Society of Municipal Improvements, with which the former association is now amalgamated, have adopted standard specifications which are better than the Toronto specifications, in that they admit good asphalts which the Toronto specifications exclude, and exclude poor asphalts, some of which, according to the experts, can get in under the Toronto specifications.

Possibly they are better than the Indianapolis specifications. At any rate, they do not name brands and the principle on which they are constructed is to specify the resulting paving material, rather than to name the acceptable asphalts and present separate specifications for each one named, thus putting the choice of asphalts to be admitted and to be rejected upon the department of public works rather than upon the expert in asphalt paving, leaving to the latter only the question as to whether the specifications have been followed, which is merely a matter of inspection, and giving him no duty in the line of determining whether the resulting pavement is a good one or not; the assumption being, of course, that the asphalts named, if laid in pavements according to the respective specifications provided, will produce good pavements. The division into classes seems to indicate that the pavements are not expected to be equally good, tho it will not be easy to distinguish the resulting pavements, methods of handling having more influence than qualities of the materials named in determining their quality.

The standard specifications of the A. S. M. I. apparently fill Mr. Law's expressed need for a standard, and they do not have the defects of which he complans. Possibly he may not agree with all of their requirements, but, at any rate, they would produce uniformity if they were followed, which is one of his desires. They are open to modification each year, but the conservatism of the body prevents the change of the specifications in any details without full and careful technical discussion, so that a proposed change must have proved its value before it is admitted.

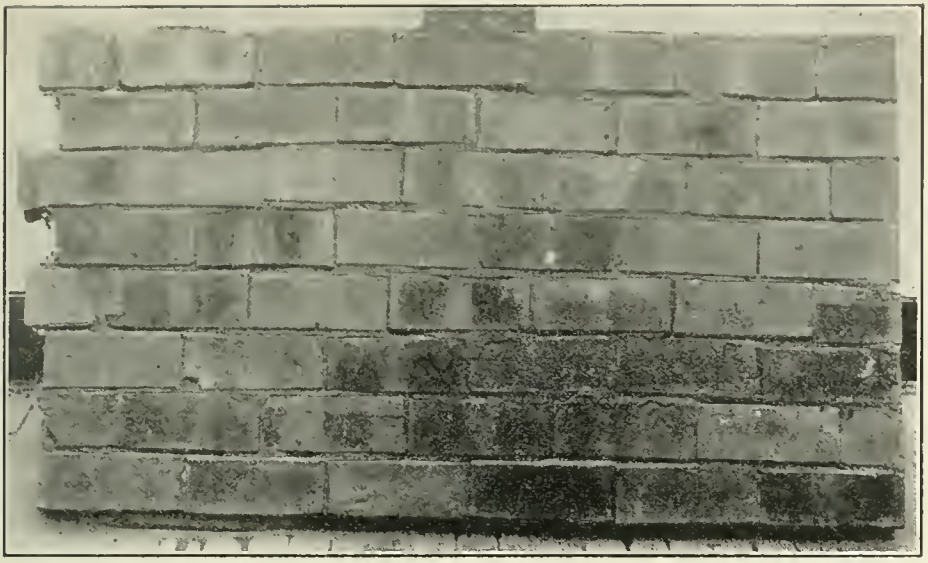
Slab Tests of Brick Pavements

For some years the State of New York has used wire-cut-lug brick for paving highways and many miles of pavement have been laid with the wire-cut-lug bricks with grooved ends to insure complete filling of joints with the cement grout filler.

A few months ago the wire-cut-lug brick was improved by the substitution of a double bevel on the ends instead of the end groove, the bevel being about 1/16 inch from the vertical, the adjoining bricks theoretically touching on a line at the center with at least a ¼-inch opening at the top and bottom. This allows for the proper penetration of the grouting material at the ends of the brick. This improved form of the wire-cut-lug brick was fully described in the April number of MUNICIPAL ENGINEERING.

When these improved bricks were first shipped to a New York State Highway job the State Highway Department was doubtful of the beveled ends. A thoro competitive test of the new form of wire-cut-lug brick with repressed brick was ordered by Mr. Ricker, the first deputy state highway commissioner, and division Engineer Wm. E. Acheson made the test and report.

Two of the accompanying photographs, which accompanied Mr. Acheson's report, show the bottoms of brick slabs made by laying and grouting the brick in the same

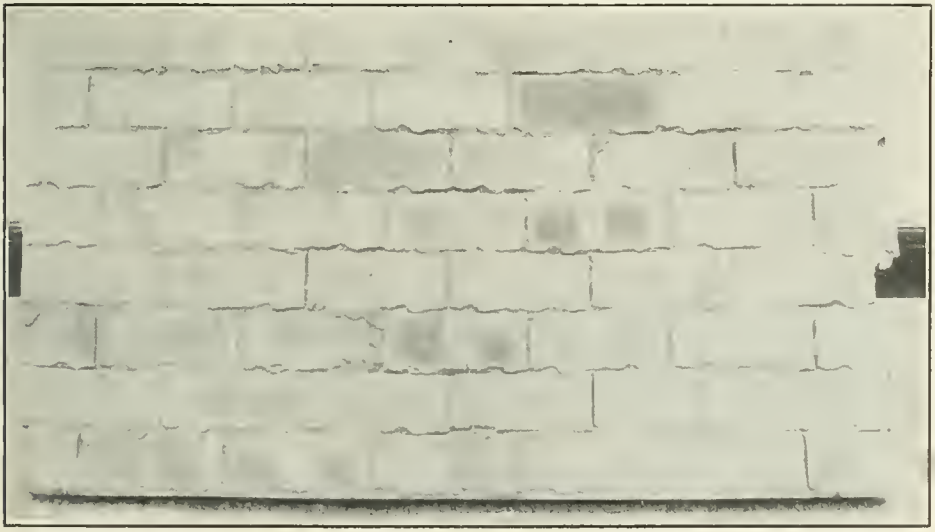


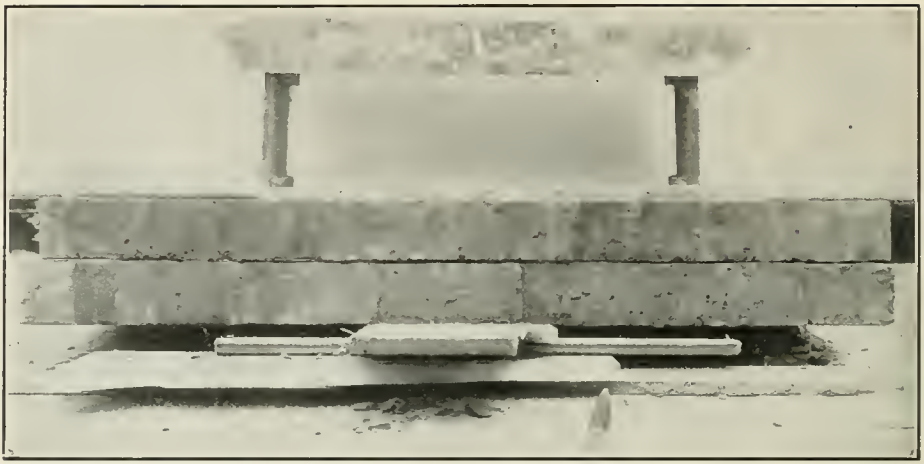
BOTTOMS *of slabs of brick pavement showing complete filling of joints with cement grout. Repressed brick slab above; slab of wire-cut-lug brick, with beveled ends, at bottom of page.*

way that they are laid in pavements, one showing the wire-cut-lug brick slab and the other the repressed brick slab. The thoro filling of the joints in both cases is clearly shown.

The slabs were then split to see how uniform the penetration had been. To split the repressed brick slab but one blow of the chisel and hammer was necessary, while blows from chisel and hammer at five different points were necessary to separate the wire-cut-lug brick slab, and the bonding cement-filler, instead of cleaving free from the brick, broke, leaving grout adhering to the faces of the brick on each side of the joint. The superior bond with the wire-cut-lug brick is attributed by Mr. Acheson to the rough surfaces of the wire-cut brick as compared with the smoother surfaces of the repressed brick.

Two of the photographs show the surfaces of the joint so split, one part of the slab being laid on top of the other





SLAB OF PAVEMENT *of wire-cut-lug brick, showing both sides of joint on which slab was split. Note grout attached to brick, the grout breaking rather than pulling off the brick. No break on end joints.*

so as to show both surfaces of the joint that had been split.

Mr. Acheson also showed that the double-beveled ends give a superior joint, for the repressed brick section could not be lifted from the floor without weakening at the end joints. The arrow in the photograph of the repressed brick joint points to one joint which broke in lifting the slab at one end. Under like test the wire-cut-lug slab remained intact, the end joints showing no tendency to yield, even tho the slab was turned end for end.

Mr. Ricker made a personal inspection of the tested slabs and admitted the beveled end wire-cut-lug bricks for use and a separate order will be issued for each contract for which they are accepted until the state specifications can be changed so as to include them specifically.

SLAB OF PAVEMENT *of repressed brick. Note clean brick surfaces. Slab broke at joint shown by arrow when lifted at one end.*

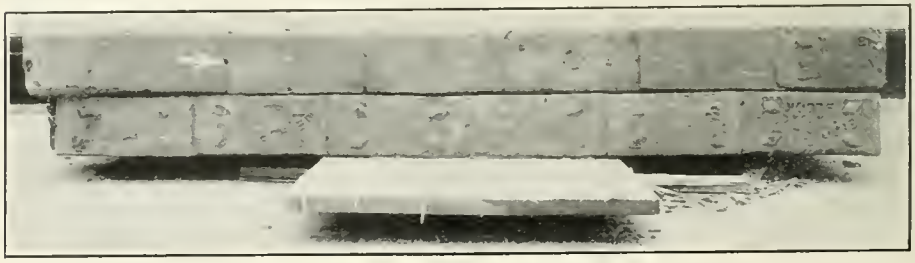
Bituminous Concrete in the Roland Park-Guilford District

By J. C. Little, Chief Engineer, Baltimore, Maryland.

This suburban development is located just north of the central portion of Baltimore City, partly within the city and partly in Baltimore County, composed of about one thousand acres of restricted land, and is considered one of the most beautiful suburban developments in this country, and, naturally, great stress is laid on the looks and durability of the roads.

On account of the high, rolling lands, some very interesting engineering problems arise in working out the curvilinear alinements, grades and intersections of the various roads, which are decided contrasts with the usual rectangular layout of cities, as can be seen by cut No. 1.

During the twenty years' experience of the Roland Park Company several types of



road construction have been used, but the bituminous concrete road bids fair to be the most satisfactory, and has been adopted as the standard form of construction.

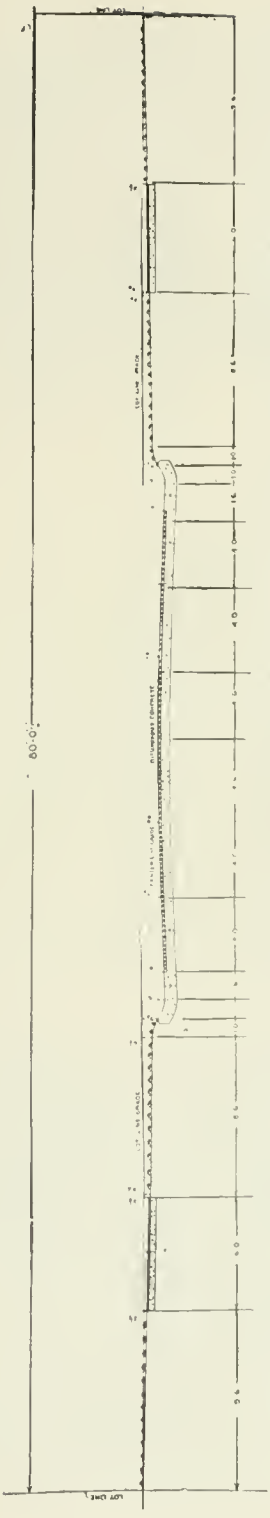
The cross-section varies according to the width of the roads, and has a very pleasing appearance, due to the uniform color from rebut to rebut and the absence of a curb. A typical section is shown in cut No. 2.

The roads are all constructed by the company and not by contract. The method of procedure can best be described by the short specifications which I have prepared for the use of the field men, which are as follows:

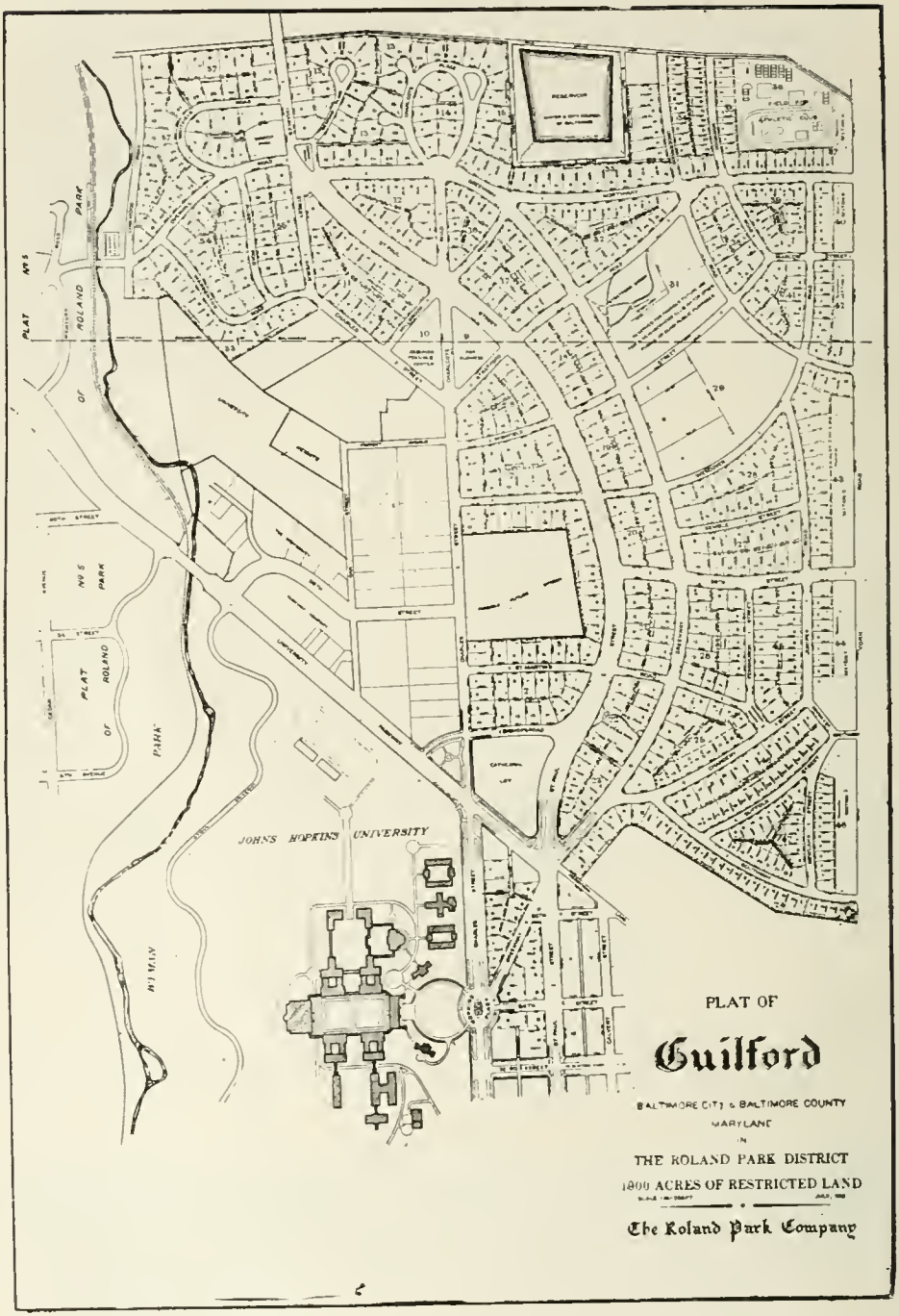
Grading and Sub-Grading: The bed of the street, or streets, will be graded to the depth and cross-section as indicated on our standard typical sections of roadway for the various widths of roadway. Lines and grades will be established by the engineering department and no work will be started until said lines and grades have been set and checked. Embankments must be made of good soil, or other material, satisfactory to the engineering department, in layers not exceeding twelve inches in thickness and thoroly compacted by a ten or twelve-ton roller.

All soft and spongy material below the sub-grade shall be removed and filled with material that will readily compact and form a solid foundation, so as not to churn up under the weight of the roller referred to above. In excavation, care must be taken not to disturb the subfoundation, except when necessary to remove any spongy material. All excess excavated material to be deposited where directed by the engineering department.

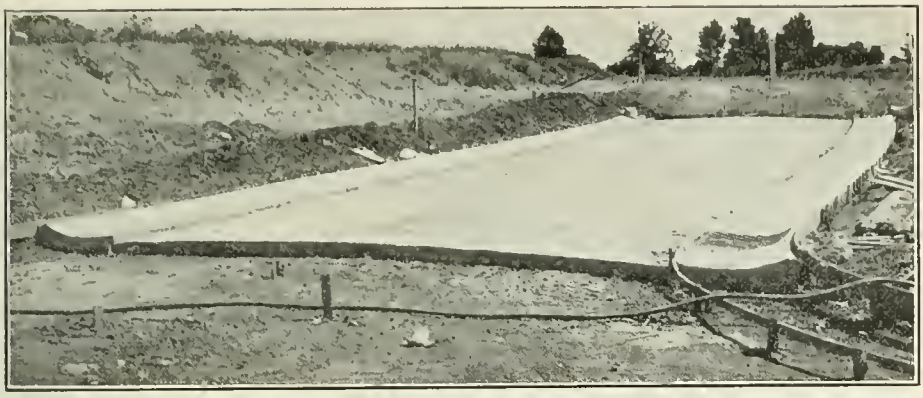
Concrete Foundation: After the subfoundation has been prepared, as above described, a concrete foundation, as shown on typical section, will be laid by using templets as directed. The concrete is to be made of the best quality of portland cement, sand and washed gravel, or broken stone, in the proportion of one part cement, three parts sand and six parts gravel, or stone. These proportions are by volume when this material is well compacted, or shaken in the measure. The engineer shall decide all questions as to how the measures are to be filled to obtain the above proportions. All cement shall pass the standard test, with latest amendments, as recommended by the Committee on Uniform Tests of Cement of the American Society of Civil Engineers. The sand shall be clean, sharp sand, free from organic matter, mud or other impurities. The gravel or stone shall be hard and sound and free from dust, sand or dirt, of a size that will pass a one and one-half inch ring and be held on a one-quarter inch screen. The con-



CROSS-SECTION *of standard road for Guilford district, Baltimore, Md. Note absence of curb and ample slopes from the lot lines to the gutters; also reduction of width of bituminous concrete pavement to twenty-five feet and the ample lawns on each side of the six-foot sidewalks.*


PLAT OF
Guilford
BALTIMORE CITY & BALTIMORE COUNTY
MARYLAND
IN
THE ROLAND PARK DISTRICT
1000 ACRES OF RESTRICTED LAND
The Roland Park Company
JOHNS HOPKINS UNIVERSITY
PLAT OF ROLAND PARK NO 5
PLAT NO 5 OF ROLAND PARK

July, 1914



CONCRETE BASE *ready to receive bituminous concrete wearing surface.*

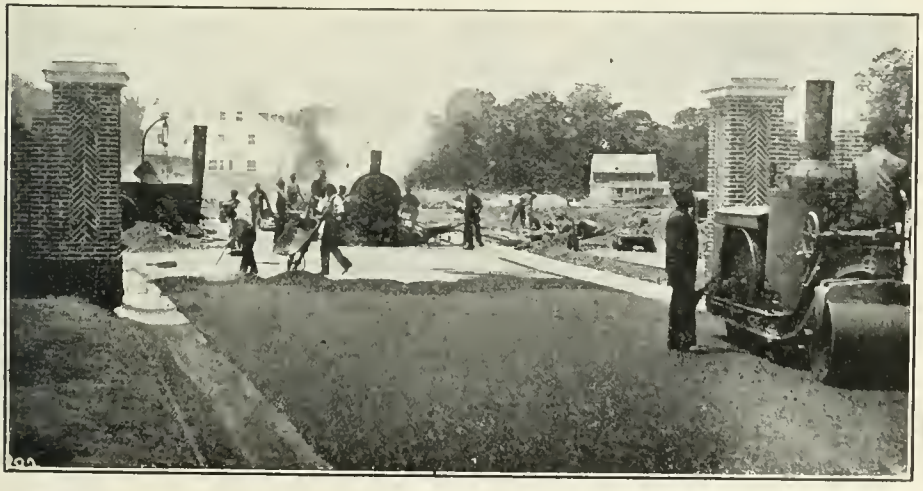
crete is to be thoroly mixed in a mechanical mixer and evenly spread on the subfoundation and thoroly rammed until free mortar covers the entire surface. If any spaces show a deficiency of mortar, such spaces are to be immediately grouted.

Expansion Joints—At intervals of every seventy-five feet, a half-inch expansion joint shall be placed the entire width of the street; i. e., from rebut to rebut. This expansion joint is to be filled with a heavy asphaltum filler, with a melting point of not less than 150 degrees F., as directed by the engineer.

Wearing Surface—After the concrete foundation has been laid, as above described, a 2-inch wearing surface shall be laid as hereinafter described. This wearing surface shall be composed of 1-inch crusher-run trap rock, varying in size from 1¼ inches down to dust, no piece of stone to have a greater dimension than 1¼ inches, samples of which are to be submitted for approval before delivery, and be subject to inspection at the quarry before shipment. The stone to be used in this wearing surface is to be kept dry and free from dirt.

The stone is to be charged into the mixing device, and after it has become perfectly dry, 7 per cent. by weight of the asphaltic cement, at a temperature of 290 to 325 degrees F., shall be added and the mixing shall continue until the contents of the mixer are a uniform bituminous concrete, and each stone thoroly coated and of such temperature as required by the engineer. The mixture shall be immediately placed in position on the street and spread to the proper

LAYING *bituminous concrete on cement concrete base.*



ST. PAUL STREET, *Guilford, after a year of unusually heavy traffic.*

cross-section and grade and then rolled, as directed by the engineer.

Immediately after the course has been rolled until there are no creases, or pockets, the surface is then to be given a flush coat of the asphaltic cement, not more than one-third of a gallon to the square yard being used, and applied with sprinkling pots and brooms of approved make.

The entire surface will then be spread with a coat of dry trap rock screenings, varying in size from ¼-inch to and including dust in sufficient quantity to absorb all of the asphalt cement that may appear on the surface.

This surface is then to be rolled until thoroly compact and hard. A sufficient amount of the screenings shall be left on the surface to protect the street while setting up. The percentage of asphalt cement to be used is subject to slight change by the engineer, depending upon the condition of the aggregate.

1. The asphalt cement to be used in cementing the mineral aggregate shall be similar in character to that used in the construction of sheet asphalt pavements, but sufficiently soft to permit its use with the aggregate, beated to about 250 degrees F.

2. The specific gravity of the asphalt and flux combined at 77 degrees F. shall not be less than .975.

3. It shall be soluble in carbon bi-sulphide to the extent of 98 per cent.

4. It shall be soluble in carbon tetrachloride to the extent of 97.5 per cent.

5. It shall show a flash point of not less than 350 degrees F. when tested with open cup and the fire point shall be above 400 degrees F.

6. The compound shall be sufficiently liquid at working temperature, so that when tested in an Engler vicosimeter at 212 degrees F., 40 cubic centimeters shall flow out in at least 3,600 seconds.

7. The solid contents must consist of asphalt only (not tar or acid sludge products), the consistency of the residue not being due to any other solid substance, such as paraffine.

8. The paraffine scale of the total compound shall not exceed 1 per cent., to be determined by destructive distillation (Holde method).

9. The asphalt must not be so susceptible to temperature changes that it will be brittle in winter, or soft and sticky in summer. It shall have a penetration between 70 aud 85 at 77 degrees F. when tested with a No. 2 needle for five seconds, under a weight of 100 grams.

10. After heating 20 grams in an open oven for six hours at 350 degrees F., the loss shall not be over 8 per cent., and the residue when tested with a No. 2 needle for five seconds with 100 grams at 77 degrees F. shall have a penetration of not less than one-half the original, or between 35 and 43.

11. It shall be absolutely free from water.

Samples to be submitted upon request, with prices.

The cost of the construction, as above described, exclusive of grading, varies from $1 to $1.10 per square yard.

A section of the concrete base, ready for application of the wearing surface is shown by Photograph No. 3.

Application of wearing surface shown by Photograph No. 4.

Photograph No. 5 shows a portion of St. Paul street, in Guilford, which has had unusually heavy traffic for the past year.

Photograph No. 6 shows another section

A NEW PAVEMENT *of bituminous concrete. Note conformity of plan to special conditions and attention paid to beauty of layout.*

of Guilford, in which the wearing surface was just completed this spring.

The combination curb aud gutter is thoroly swept and then coated with a tar product, to which stone chips are added. This form of construction is not altogether an experiment of the writer's, for in 1911 several streets were paved under practically the same specifications by contract at Annapolis, Md., under my supervision, at a cost of $1.06 per square yard. This work has given very satisfactory results and is in excellent conditio ntoday.

Concrete Roads and Streets in the United States

During 1913, concrete was actually laid in thirty-seven states and in the District of Columbia, and in thirty-eight states and the District of Columbia in 1912, and no sidewalk construction is included.

There were 907,300 square yards of all types laid in 1912 and 1913, but not divided as to years, which will account for this work being shown in a separate item in the table. In some sections, work is continued, owing to mild weather conditions, thruout the year, and no division was made as to the yardage built in each year. In other cases, contracts were awarded and work started late in 1912, and completed after the opening of the construction season in 1913, while in a few cases, reports received from various sources did not divide the yardage on some roads or streets, while this was properly divided on others.

The following table shows the amounts of paving constructed in all states in 1912 and 1913:

Type of Paving	Sq. Yds. Laid in 1912	Sq. Yds. Laid in 1913	Sq. Yds. Laid in 1912 and 1913*
One course	2,960,930	2,490,738	5,451,668
Two course	1,263,600	1,251,710	2,515,310
Bituminous top	3,331,750	1,093,608	4,425,358
Hassam	281,000	281,900	562,900
Unknown as to type	256,080	14,200	270,280
Totals	8,093,360	5,132,156	13,225,516
*To which should be added paving constructed in 1912 and 1913 and not separated as to year			907,300
Total concrete paving in 1912 and 1913			14,132,816

In the nineteen years ensuing from the laying of the first section of concrete until the close of 1911, a total of 4,303,200 square yards of concrete paving of all types was laid. In the following year, 1912, there were 5,132,156 square yards,

or an increase of over 20 per cent. But in 1913, the total reached 8,093,360 square yards, or an increase of 57.7 per cent. over 1912. None of the 907,300 square yards of paving laid partly in each year is included in these figures, so that as most of this 907,300 yards was laid in 1913, the increase is conservatively estimated at 75 per cent. over 1912.

During the present year, from reports that have already been received, there will he a still greater ratio of increase. As there have already been either contracted for, or positively decided upon, over 14,000,000 square yards of all types of concrete paving, there is no hesitation in estimating that there will be at least 18,000,000 square yards laid in 1914. New York state is already preparing to build over 120 miles of concrete, Ohio builds 24 miles in one section in Muskingum and Licking counties, California expects to at least double and probably triple the 1,766,000 yards constructed last year, and nearly all of the other states that have already reported, advise that they will make substantial increases over the figures for last year.—*Better Roads.*

Better Roads Cut Living Cost

The building of good roads is the most important factor which this country must consider in the next few years. The improved highway is the one means of salvation for the poor man, for in these days of high cost of living, we must look to the cheaper transportation of food stuffs as our way out. We can no longer expect to better our condition thru a greater supply of necessities, for every effort we have made toward lowering the cost of food stuffs heretofore has been met with the response that the United States is now about as intensively cultivated as it can be under present conditions.

In other words, our people are no longer turning to the country in an effort to produce a larger amount of food. Therefore we must face the problem of getting along with the same amount that is now produced.

The only solution left for us is to cut out cost of production and delivery. The best way to accomplish this is to provide good roads, for we have already had many demonstrations of how good roads will work to our advantage.

The improvement of highways in many parts of our country in the last few years has been invariably followed by better living conditions. Where the roads leading into a large city have been improved we have seen an increased supply of food stuffs on the local markets and a larger number of farmers bringing their products into the city. This, of a necessity, results in lower prices for the products and a long step toward better living conditions.

On the other hand, the improvement of roads thruout the country is invariably followed by an improvement in farming methods. The agriculturist who heretofore devoted his energies to grazing and the production of rough food stuffs, such as corn, is now turning to what is known as market gardening. He is raising potatoes, beans, peas and other commodities that are in every day demand, simply because he can get them to market where heretofore markets were denied him. It is uo uncommon sight now to see farmers driving eighteen or twenty miles to market with loads of produce which before the highways were improved were denied the consumer. The automobile, it is true, has had a great deal to do with increasing this supply, but even this vehicle would be helpless without highways on which to run.

The advent of good roads, too, has brought about another revolution, that of intensive farming. The countries of the old world have always regarded us a criminally wasteful people, in that the product raised on 100 acres of land in this country was often less than they produced on ten acres. Good roads have changed this condition. The American farmer now finds that he will get a greater return from one acre of land intensively cultivated than ten acres farmed in the old slipshod methods would heretofore produce. This intensive farming is the direct result of good roads, for where the farmer heretofore found it necessary to cultivate crops which made a large bulk so that his infrequent trips to market were profitable, he now finds that he can take a small load to the consumer as often as he desires.

Good roads are an undisguised blessing, and this every one who has given the matter any thought will admit. They not only promote increased industrial activity, and therefore better the living conditions of thousands of our city dwellers, but they provide an improved social life for people who live in the country. The family which has access to a good road, and therefore quicker and more pleasant trips, goes to church oftener, visits the neighbors oftener and attends farmer club meetings more frequently. No one can deny that all of these are important factors in the farmer's life.

Good Roads in Fairfax County, Va.

Fairfax County, Va., will build 33 miles of tar macadam roads in the Mount Vernon district, work having been begun by the contractors. The county voted $90,000 in bonds for the work last fall, the state contributes $10,000 and the United States government contributes $16,000, the total cost being $116,000.

Municipal Notes

Water Filtration for Detroit

Theodore A. Leisen, who has just assumed his new duties as the chief engineer of the water works of Detroit, Mich., states that the next great improvement needed in the system is a filtration plant, the cost of which, for the 200,000,000 gallons a day capacity required, he estimated at $2,000,000 to $3,000,000.

Detroit is now using hypochlorite to some extent, but Mr. Leisen does not consider it a substitute for filtration, but rather as a supplementary treatment. He also recommends sewage purification for the city.

Mr. Leisen comes to Detroit from the Louisville water works, of which he has been superintendent and engineer for several years, and he succeeds Geo. H. Fenkell, who was appointed commissioner of the department of public works some months since.

Muscatine, Iowa, Investigates Municipal Lighting

Prof. J. B. Hill, of Iowa City, has reported to the City Council that to make a new municipal electric lighting plant a success financially, including all capital charges, it would be necessary to charge the city $80.07 per arc lamp per year, $27.34 per tungsten lamp, and $46.60 for five-light electrolier, and to receive from private customers 11.7 cents per kilowatt hour. This is practically the same that the city is paying at present for arc lamps and $2.34 more than it is paying for gas and gasoline lamps. These figures are for a load factor of 13. If the time of using electricity can be increased so that the load factor can be made 20, the lighting peak remaining the same, 352 kw., the combined load factor with the street lights will be 24.9 instead of 19.3, as in the above estimate, in which case arc lamps would cost $76.60 per year, tungstens $26.25 and five-light electroliers $44.86.

On the latter assumption the average price to private consumers must be 8.05 cents per kw. hour.

The Muscatine Lighting Company has the advantage of a railway load, so that it can offer the new price of $65 per arc lamp, and should, according to Prof. Hill, make the 100-watt tungsten price $23 a year. He also recommends that the primary private current rate be reduced to 11½ cents net per kw. for the first 30 hours' use.

Denver Commission Government

The semi-monthly publication of the city of Denver, which is free to taxpayers on request, in its issue dated June 13, 1914, has a statement from each of the commissioners regarding the first year's work under the commission form of government.

Commissioner J. B. Hunter, of the department of improvements, shows a reduction in the total expenditures for maintenance and operation, of nearly $200,000, most of which is due to reduction in expense of street cleaning and repair, and special flood repair and boulevard funds. He shows a similar reduction in cost of improvements paid for by special assessments, tho four-fifths of these expenditures were provided for by the preceding administration. The commissioners in charge of the departments of safety, social welfare, finance and property make general statements, mainly showing that the first year was less than a half year under the new form completely and results must not be expected for another year.

The finance department shows a reduction of $20,000 in the amount used in operating the six departments under his charge in 1913 from that used in 1912 under the old form of government, and a further reduction in amounts appropriated for use in 1914 of over $40,000.

The auditor devotes his statement to criticisms of the provisions of the law which show lack of familiarity with the needs of municipal government, which he summarizes as follows:

"We need an executive head and fixed responsibilities, a mayor and comptroller, and men of fixed policies and nerve to lead—and if necessary to lead alone.

"Specifically, an unnecessary $12,000 city newspaper, an unnecessary $6,000 mayor's office and no mayor, an over-officered and expensive charity bureau, an expensive tho beautiful and distant poor farm. Too many automobiles and chauffeurs. Lack of a store house for supplies, making waste and increased cost. An expensive and poorly administered health department. Inefficient revenue and license ordinances. Too many employes in nearly all departments and in the courts. Lack of equalization of salaries as compared with responsibilities attached thereto. Too many independent commissions and courts and officers with power to incur liabilities against the city. The lack of an independent city attorney, who, being appointed by the commissioners, must do their will. Too many boards and and officers under the commissioners supposed to have been abolished, thus shirking and dividing responsibility and increasing expenditures."

Commission Government in Grafton, W. Va.

Grafton, W. Va., in response to a request from Mount Pleasant, Mich., has sent full information about the present form of government with a statement that it is meeting with general approval. Mount Pleasant is considering the commission form and the city manager form of government.

A College of Engineering on the Co-operative Plan

The College of Engineering of the Municipal University of Akron was established in 1914. Applicants will be assigned to shop work in July, 1914, and accepted as students in September, 1914.

The "Cincinnati plan" has been adopted and offers a five-year co-operative course in engineering. This requires the practice of engineering to be learned under actual commercial conditions, and the science underlying this practice to be taught in the university by trained educators. Its aim is to give the student a thorough training in both the theory and the practice of engineering. The students are grouped in two sections, one of which is at work and the other in attendance at the university. Thus, during any weekly or bi-weekly period, one-half of the students are at the university and one-half are in the shops. At the end of the period, those who were at the university go to the shops, and those who were in the shops go to the university.

Five years of eleven months each are required to complete the course. Each student is allowed a vacation of one week at Christmas time and three weeks in the latter part of the summer.

The number of students that can be accepted in the fall of 1914 is limited, both by the positions open in the factories of Akron and by the facilities of the University; therefore, applications for admission should be filed with the Dean of the Engineering College before July 1, 1914. Students applying after that date will be admitted if any positions remain open, or if any vacancies occur due to resignations.

While a student is at work, he is subject to all the rules and regulations imposed by his employer upon the other employes. All existing labor laws and conditions, including those pertaining to liability for accident, apply to the student the same as to any other employe.

In order to operate a co-operative course in engineering, the Engineering College must be located in or near an industrial center. Akron, O., is essentially a manufacturing center, and this type of engineering education was selected as being the latest and the one best adapted to the city's needs. No other courses in engineering will be offered.

Concrete Trestle in California Highway

The engineer's estimate for the construction of the trestle described in the June number of MUNICIPAL ENGINEERING, vol. xlvi, p. 517, was $215,634.06.

Bids were opened on June 8 and the lowest bidder was the Sound Construction and Engineering Co., of San Francisco, at $238,823.82, for pile substructure with the deck cast in place instead of in slabs as described in the article referred to. The bid on the 2,318 feet of timber trestle was $11.95 a foot; on the 13,851 feet of concrete trestle was $13.72 a foot. To each of these must be added the asphalt surfacing of the roadway, on the 32,230 square yards of which the bid was 65 cents a square yard. The 20 monuments were bid at $14 each.

The highest bid was for use of the Thomas unit system with 34-foot spans between bents, $397,069.60.

Sterilization of Water Supply of Erie, Pa.

During 1913 all the water supplied to the city of Erie, Pa., was sterilized by the use of calcium hypochlorite, altho, on account of the excellent bacteriological con-

dition of the lake water during the summer months, the use of the sterilizing solution was precautionary rather than necessary.

Once, early in December there was objectionable taste and odor in the water due to the hypochlorite. This occurred because the sudden chilling of the water caused a slow breaking up of the sterilizing solution, which was being used at that time slightly in excess, because of the excessive stirring the lake had received during heavy wind storms.

The proportion of hypochlorite used averaged 7.35 pounds per million gallons during the year. The monthly average efficiency of the process from April to December, inclusive, is shown by the percentage of bacteria removed, which varied from 88.7 per cent. in October, to 96.9 per cent. in May. The cost of the 45,136 pounds of hypochlorite used was $595.81, and the cost of treating the water averaged 74.6 cents per million gallons.

All the water used passes through settling basins, which remove from 16.7 to 50 per cent. of the turbidity, averaged by months. A filtration plant is completed and put in operation this year.

Sewer Excavation With a Revolving Shovel

George Hyman, of Washington, D. C., has been operating a revolving shovel for digging sewers in and about the city of Washington. The success which he has attained makes it well worth while to study his method of operation.

The shovel is equipped with a 27-foot handle, enabling it to dig to a depth of 18 feet, below the bottom of the wheels. The dipper has a capacity of ⅞ of a cubic yard. It is fitted with five forged teeth, three on the front, and one on each side. These teeth are intended as side cutters in order to assure sufficient clearance to lower into the ditch easily after a cut has been made. The neatness of the ditch cut is very noticeable.

Mr. Hyman has used this machine recently for digging ditch for sewer pipe and also for concrete and brick sewer. The most recent job was a ditch for an 18-inch sewer pipe. This ditch is 3,300 feet long, varying from 10 to 27 feet in depth. The material is hard clay with a little shale at the bottom. As some of the work was done when the bottom was somewhat frozen the digging was very hard.

For the concrete and brick sewer, the shovel excavated a trench 18 feet deep, seven feet wide at the top and an average of five feet at the bottom. This sewer had a concrete invert and a brick arch. The speed of the building of the invert and the brick arch governed the whole progress of the work. The shovel under these conditions made about 65 feet advance a day, but this naturally is not an index of its capacity.

The material was loaded into two-yard side-dump cars traveling on light rails laid alongside the trench. This material was hauled back and dumped directly into the backfill. This method was pursued whenever possible. In a few places, however, owing to local conditions, it was necessary to overcast a small amount of material, which was later rehandled. The excess material not required for backfill was taken away in wagons. The bracing of the trench was put in by hand and small jack screws at the ends of the blocks held the sheeting in place.

Two men were used for pushing the cars, altho at times a mule was employed.

The concrete invert was laid immediately back of the shovel in the trench dug by the shovel on the preceeding day. The brick arch was built on the second preceding day's invert and was allowed to stand a day before the backfill was placed upon it. This, as will be seen, left 200 to 300 feet of open excavation. Hence it was necessary only to keep the shovel ahead of the concrete gang.

The organization of the job was so well planned, that a very few men were employed.

The shovel is mounted on traction wheels, to which are riveted circumferential bands formed of channel iron, which give a double flange on the wheel. The shovel runs on rail sections about three feet long, mounted on 12x12-inch timbers. These timbers, seven in number, span the trench. They are in reality long chair ties. In order to move forward a chain sling, hung over the dipper handle, was hooked into l-bolts in the chair ties, or timbers.

Mr. Hyman deserves much credit for the efficient organization of his jobs.

Consumption of Wood Preservatives in 1913

Statistics compiled by the National Wood Preservers' Association in cooperation with the U. S. Department of Agriculture show that during 1913 the consumption of wood preservatives by the 93 treating plants reporting amounted to 108,373,351 gallons creosote oil, 26,466,803 pounds dry zinc chloride, 3,883,738 gallons miscellaneous liquid preservatives, and relatively small amounts of corrosive sublimate. Compared with 1912 there is shown an increase in consumption of 29.5 per cent in creosote oil, 27.5 per cent. in zinc chloride, and 26.46 per cent. in miscellaneous liquid preservatives.

MISCELLANEOUS

The Society for Electrical Development

The Society for Electrical Development held its second annual meeting on June 1 at the Bellevue-Stratford hotel, Philadelphia, Pa. J. M. Wakeman, general manager of the society, reported that the best men available to carry it on had been secured. This work has been divided into sections as follows: Field co-operation, new development, commercial exchange bureau and editorial and advertising. The activities of the society are well directed by the following staff: George Barton Muldaur, M. E., is in charge of the work of the first section and Robert N. Lee has been engaged to assist him. Mr. Muldaur will travel about the country forming co-operative leagues for more intensive local development of the industry, aiding architects and builders to arrange for complete electric service instead of lighting alone, bringing textbooks and lecture courses up-to-date, etc. John P. Mallett, M. E., will investigate the present uses of electricity in various industries and report how these applications can be extended. Theodore Dwight, who is in charge of the commercial exchange bureau, will secure and index information regarding the uses of electricity. This information will be at the service of the members of the society. The editorial and advertising department is in charge of H. C. Spaulding. L. G. Harkness-Smith has been placed in charge of a department which will aim to illustrate by means of motion pictures the uses of electricity in the home, mill, factory and farm. A window trimming department has also been organized and placed under the supervison of A. J. Edgell. Sample electrical displays are being set up in windows and photographs taken and distributed among the members of the society. Printed instructions on how to trim the windows are sent with the illustrations.

Mr. Wakeman further reported that the society membership consisted of 298 central stations, 186 manufacturers, 272 jobbers and dealers, 588 contractors and 23 miscellaneous industries. He said that the society was still desirous of increasing its membership in order that the development work may be made more extensive.

The following members of the board of directors were elected: To represent the central stations, J. E. Montague, Niagara Falls, N. Y.; manufacturers, H. B. Crouse, Syracuse, N. Y.; jobbers and dealers, Fred Bissell, Toledo, Ohio; and contractors, G. M. Sanborn, Indianapolis, Ind., each to serve four years.

The following officers were elected: President, Henry L. Doherty; first vice-president, W. H. Johnson; second vice-president, A. W. Burchard; third vice-president, W. E. Robertson; general manager, J. M. Wakeman; acting secretary-treasurer, James Smieton, Jr.

Technical Associations

The meeting of the American Society of Engineers, Architects and Contractors at its meeting July 3 will discuss industrial accidents, concrete house construction, and related subjects, and on July 4 will devote its time to good roads.

The eighteenth annual convention of the Central States Water Works Association will be held at the Windsor Hotel, Wheeling, W. Va., Aug. 25, 26 and 27. R. P. Bricker, secretary, Shelby, O.

At its meeting June 10, the Ned York Electrical Society listened to a paper by William P. Kennedy on the electric vehicle in New York City and elected Frederick. A. Scheffler as president and George H. Guy as secretary.

The Federation of Trade Press Associations will meet at Congress Hotel, Chicago, Sept. 24, 25, 26.

The Chicago cement show will be held in the Coliseum Feb. 10 to 17, 1915. This will be the only cement show held by the organization in 1915.

The Atlanta convention of the American Highway Association will be held Nov. 9 to 14.

The second international safety exposition will be held at the Grand Central

Palace, New York City, December 12 to 19, under the auspices of the American Museum of Safety, 29 W. 39th St.

Technical Schools

The Iowa Engineering Experiment Station was established at the Iowa State College by the Legislature of Iowa in 1904, to meet the demands made upon the college by industrial, urban, and agricultural interests for information and assistance. Since its creation, its growth has been rapid, and the demands upon it have more than justified its existence. From the first the station has carried on original investigations along lines of vital interest to the people of Iowa, and has published the results in bulletin form for free distribution. The station is constantly receiving from cities, counties, corporations, and individual citizens of Iowa, samples of cement, brick, tile, sewer pipe, asphalt, iron, steel, wood, stone, gravel, sand, clay, cement materials, fuels, water, sewage, etc., with the request that they be tested or analyzed, and the results reported. The volume of such work is increasing, and more and more the Engineering Experiment Station is coming to be considered the final authority to decide many questions of quality of materials, or the value of fuels, clays and other materials. For such tests, the station makes low charges, just safely covering the actual cost of the work. The station is equipped to make practically any test desired, and has on its staff men whose knowledge and experience fit them to advise upon all phases of industrial and engineering work, including civil, illuminating, mining, mechanical, electrical, and agricultural engineers, industrial chemists and ceramists.

"Tests of Bond Between Concrete and Steel," by Duff A. Abrams, has just been issued as Bulletin No. 71 by the Engineering Experiment Station of the University of Illinois. In designing structures of reinforced concrete it is important to know the amount of stress which may be developed between the surface of the reinforcing bars and the surrounding concrete before failure is produced by the slipping of the bars. This stress is what is commonly termed "bond." The abovementioned bulletin gives the results obtained by pulling out bars embedded in blocks of concrete and also the results of tests made to study the bond stresses developed in large reinforced concrete beams. Nearly 2000 tests are reported and a wide range of conditions are represented. This is one of the most exhaustive studies of the amount and distribution of the bond stress between concrete and steel which has appeared.

"The Tractive Resistance of a 28-Ton Electric Car," by Harold H. Dunn, has just been issued as Bulletin No. 74 of the Engineering Experiment Station of the University of Illinois. It records the results of tests made to determine the tractive resistance of a 28-ton electric car when running on straight track in still air. The tests were planned so as to eliminate wind resistance. The results are finally expressed in the form of a curve whose co-ordinates are car resistance and speed, which shows that the resistance varied between 5.25 pounds per ton at 5 miles per hour, and 26.12 pounds per ton at 45 miles per hour. The bulletin contains also a description of the car.

A course in engineering administration is added to the curriculum of the Massachusetts Institute of Technology, in which three-fourths of the time is devoted to engineering and scientific branches and one-fourth to business subjects, including the fundamental principles on which modern accounting is based, cost keeping, characteristics of various investments, transportation, industrial organization, business management and business law. The engineering studies may be taken in the civil, mechanical, electrical or chemical courses.

The Massachusetts Institute of Technology has established courses in highway engineering in the department of civil and sanitary engineering under the general supervision of Professor Charles M. Spofford, the head of the department and in charge of Professor Hector J. Hughes. These courses are for undergraduates rather than being for postgraduates.

Publications Received

Lefax sheets for May, June and July cover natural gas, mine accidents, ores, surveying, hydraulics, cement, logarithms, plate girders, steam turbines, bolts, mechanical and electrical engineering, earth work and radium. Standard Corporation, Pennsylvania Bldg., Philadelphia.

A new series of data cards is issued by The H. A. Strauss Data-Card Service, Harris Trust Bldg., Chicago, Ill.

The June issue of "Data," published by Engineering Contracting, Chicago, Ill., carries the number of sheets to 1088.

Preliminary Report to the Mayor and Aldermen by the Chicago Municipal Markets Commission. Frederick Rex, secretary, 1005 City Hall.

The City Manager Plan of Municipal Government, reprinted from Beard's Loose Leaf Digest of Short Ballot Charters, 36 pp., 25 cents.

Report of the Public Service Commission for the first district of the State of

New York, Vol. II. Statistics of transportation companies for year ending June 30, 1912. A. I. Weber, chief statistician, New York City.

Forty-seventh annual report of the Commissioners of Water Works of Erie, Pa., for years 1913. E. J. Morton, civil engineer.

Decision of the Supreme Court of the United States in the Kansas rate regulation case, together with the dissenting opinion. Issued by T. R. Weddell, secretary, 160 W. Jackson Blvd., Chicago, Ill.

The proceedings of the 33d annual convention of the American Water Works Association, held at Minneapolis, June 23-27, 1913, fill a cloth-bound volume of 750 pp., full of good material. John M. Diven, secretary, Troy, N. Y.

The proceedings of the 9th convention of the Natural Gas Association of America, held at St. Louis, May 19-22, 1914, are very prompt in their appearance.

The proceedings of the tenth convention of the American Road Builders' Association, held at Philadelphia, Pa., Dec. 9-12, 1913, have been received. E. L. Powers, secretary, 150 Nassau St., New York City.

Ninth annual financial and departmental report of Edmonton, Alberta, for 14 months ending with 1913. A. J. Latornell, city engineer.

Annual report of the commissioner of public works of St. Paul, Minn., for 1913. Oscar Claussen, commissioner.

Unpopular Government in the United States," by Albert M. Kales, professor of law in Northwestern University. Cloth, 272 pp., $1.50 plus postage on 24oz. University of Chicago Press, Chicago, Ill. Showing the rise of the "politocrats" and how unpopular government was established in this country, and methods in use and in process of development for restoring popular government.

Report of the Investigations on Drain Tile of Committee C-6 on standard tests and specifications for drain tile, of the American Society for Testing Materials, published as Bulletin 36 of the Engineering Experiment Station at Ames, Iowa.

Proposed charter for the city of St. Louis, prepared by the Board of Freeholders elected by the people, April 1, 1913. Wilbur B. Jones, secretary, 329 Municipal Courts Building, St. Louis, Mo.

Report of Board of Public Works of Little Falls, N. Y., for 1913. O. J. Dempster, city engineer.

Brown's Directory of American Gas Companies, ($5) for 1914 is a cloth bound volume of over 800 pp., containing all sorts of information and statistics concerning gas companies, artificial and natural, acetylene and gasoline, parent or operating companies, public service commissions, prices of gas securities, operations of prominent companies, associations of gas men, books on the subject, etc. Published by The Gas Age, 280 Broadway, N. Y.

Civil Service Examinations

The U. S. Civil Service Commission will hold examinations at the usual places, as follows:

July 8—Assistant physicist in Bureau of Standards, at $1,400 to $1,800 a year. Landscape architectural draftsman in Engineering Department at large, at $900 a year. First-class steam engineer for position of assistant engineer and electrician, at $1,200 a year.

July 13—Metallurgical engineer for work in iron and steel, in Bureau of Mines, at Pittsburg, Pa., at $3,000 to $4,500 a year. Assistant mining engineer in the field, Bureau of Mines, at $1,800 to $2,400 a year.

July 22—Transitman in Forest Service in Southern Appalachian and White Mts., at $800 to $900 a year.

July 22, 23—Mechanical draftsmen for Panama Canal service, at $125 to $150 a month.

August 3—Chemical engineer in Bureau of Mines at Pittsburg, Pa., at $2,400 to $4,000 a year.

Personal Notes

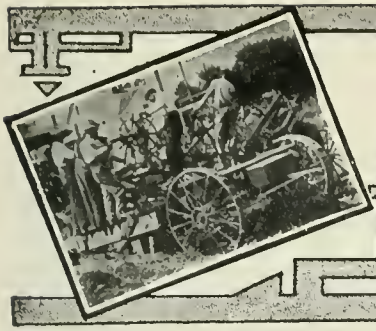
Hering & Gregory, consulting engineers, New York City, have been retained by the Board of Contract and Supply of Albany, N. Y., to investigate and report on the best method of collecting and disposing of the garbage, rubbish and ashes of the city.

C. E. Hix, recently superintendent of the power plant at McColl, S. C., has gone into the business of electrical contracting at Spartanburg, S. C., as manager of the Spartan Electric Company.

Mr. Keppelle Hall, who for the past fifteen years has been actively engaged in engineering work of considerable magnitude, has joined the organization of Sanford E. Thompson, consulting engineer, Boston and Newton Highlands, Mass.

C. W. Boynton, formerly with the Baltimore & Ohio Railroad, and for the past ten years inspecting engineer of the Universal Portland Cement Co., has resigned his position to take charge of construction and operation for the Sonoma Magnesite Co. in developing its properties in California.

W. M. Kinney, assistant inspecting engineer, who has been in charge of the Universal Inspection Bureau in Pittsburgh during the past six years, has been selected by the Universal Portland Cement Co. to take up the work left by C. W. Boynton.



MACHINERY AND SUPPLIES

Efficiency in Road Building Equipment

In these days when good, permanent roads and streets have become such an absolute certainty, paving machines many and various in style and build are being placed upon the market. Naturally, street and road contractors are keeping their eyes wide open, and are grasping with intense interest every feature fo advantage which goes into the making of such machines, all being carefully studied as brought out.

The M-C rail-track paver, manufactured by the Marsh-Capron Mfg. Co., of Chicago, is attracting a great deal of attention, because of its simplicity, its ease of operation, its strength, and the general service it is giving in street and road work. The company are very enthusiastic about its future, and the words of commendation and congratulation they are receiving from contractors and engineers throughout the country, cause them to believe that their machine is just what the contractors have long been waiting for.

For a number of years the Marsh-Capron Company have been manufacturing concrete mixing machinery for building work. They started out with the determination to give the contractors full value for their money and it was not until they had carefully studied the needs of the building trade and learned just what contractors were up against that they commenced operations. Their machines have been acknowledged everywhere successful.

Among the advantageous features, patented, are the steel rail tracks which are placed around the drum. The company spent much time and many thousands of dollars in perfecting this wear-proof feature, and all their equipment now, as the name "rail-track" implies, is furnished with these rails as a protection for the drum.

Roller-bearing, dust-proof car wheels for the steel tracks to roll on is another unusual and effective feature. These mean easy operation, and will last indefiuitely, without bother or attention.

A feature of great importance is the segmental gear, and no one appreciates the value of this more than the contractor who has had the misfortune to have broken this part of his mixer. When the gear is cast in one piece and a break occurs, much time and money is required before the mixer is again ready for operation, but when the gear is cast in segments it is an easy matter to replace a part, should it become broken, and the cost is trivial.

Submerged grease cups mean easy lubricatiou without the annoyance of having to watch them to see that they are not filled with dust or concrete.

The accompanying picture shows the M-C rail-track paver on the job in Wilmette, Ill. Note carefully its difficult position. It is in just such cases as this, the manufacturers say, that the machine best shows its worth.

Paving an intersection naturally calls forth all the flexibility and speed of the best paver. The facts that there are four corners to be laid, and that concrete sets quickly, make it difficult, unless the machine is especially efficient and easy to handle, to connect all the ends into a perfect and continuous stone, before any of it has set.

In the picture will be noted (1) that the north end of the street has just been finished. The paver is now working on the short stub of the west side (4). When this is finished it will turn end for end and do the east side stub (2). Then the block to the south (5) will be laid.

An obstacle that would have puzzled most operators is the manhole (3), which interferes with the paver moving in a straight line from one position to another. It was accomplished in this instance with comparative ease.

It is generally known that specifications for roads vary in different parts of the country, in accordance with the various traffic conditions that must be met. Contractors' methods in laying concrete pavement also vary considerably.

M—C RAIL TRACK *paving mixer at work at Wilmette, Ill., showing order of construction of street intersection at treatment of manhole.*

Concrete mixers for paving work are called upon to meet many different conditions, and it is the aim of mixer manufacturers to make their machines as flexible as possible. A paving mixer must be able to lay anything from a city street 40 feet wide to a 12-foot country road, and it must be able to do this in the most convenient and efficient manner. The same type of distributer that is necessary on very wide streets is, naturally, entirely unadapted for narrow roads.

The M-C rail-track paver is built with the idea in mind of giving the greatest convenience in road and street work. The mixing distributer, for wide streets, is a remarkable piece of machinery, doing away with bucket arrangement, and guaranteeing more mixing, because the concrete after it leaves the mixer drum is conveyed thru this distributing trough by means of a worm conveyor, which mixes as it delivers. Delivery is expedited by means of four gates in the bottom of the trough, opening at four points, about 4 feet apart. The concrete is, therefore, deposited in just the right proportion, and at just the right distances to make its handling most convenient. The distributer is a simple piece of mechanism, requiring no expert to manipulate it successfully. In fact, one of the cheap labor hands on the street can easily take care of the levers which let down the concrete as desired.

For road work and for streets up to 24 feet wide, a simple steel chute is provided as the most efficient distributer. This is furnished in various lengths to suit conditions, the general call being for the 8 and 10-foot sizes. The 10-foot delivery chute of the M-C paver hangs on an incline of approximately one in three. The 8-foot chute, of course, is a little steeper than this.

The Marsh-Capron Company contend that a three-to-one slope is just as flat as can be used to advantage on a paving mixer. The cry is now for medium dry concrete. To quote the words of Prof. Blanchard in the paper he presented at the National Conference of Concrete Road Building: "The amount of water in the concrete should be such as to cause it to settle to a flattened mass—but not sufficient to cause it to flow readily on the sub-grade. The consistency should be such as not to require tamping, but not so wet as to cause a separation of the mortar from the coarse aggregate in handling and placing. If there is an excess of water on the surface, or the mass has a tendency to flow or settle out of position after being floated, the concrete has been mixed too wet."

The Marsh-Capron engineers contend

that concrete of the consistency advocated in this paragraph will not flow on a chute that has not an incline of at least one in three. It is true in some building operations, in which concrete is placed in the forms by spouts several hundred feet long, that the concrete is mixed wet enough to flow on a one in four, or even on a one in five slope, but such concrete is entirely too wet to meet the best practice in concrete road work.

Many concrete roads are being laid in two courses. The first course, 5 or six inches thick, is laid; then, as a rule, strips of reinforcing wire or expanded metal are laid on the top of this course. The finish of the top or wearing surface is then put on and floated. This top surface is generally 2 inches in thickness.

There are two ways in which the work of laying a 2-course road can be done economically. First, with two mixers. The regular paving machine will go down the street and lay the first course. A couple of men will follow, putting the reinforcing in place. A second machine, of a much smaller type, such as the "Little Devil" mixer (which is also manufactured by the Marsh-Capron Mfg. Co.), follows, mixing the top surface and operating at the side of the road. These machines are light and easily moved, and their daily capacity is ample for the small amount of wearing surface they have to mix.

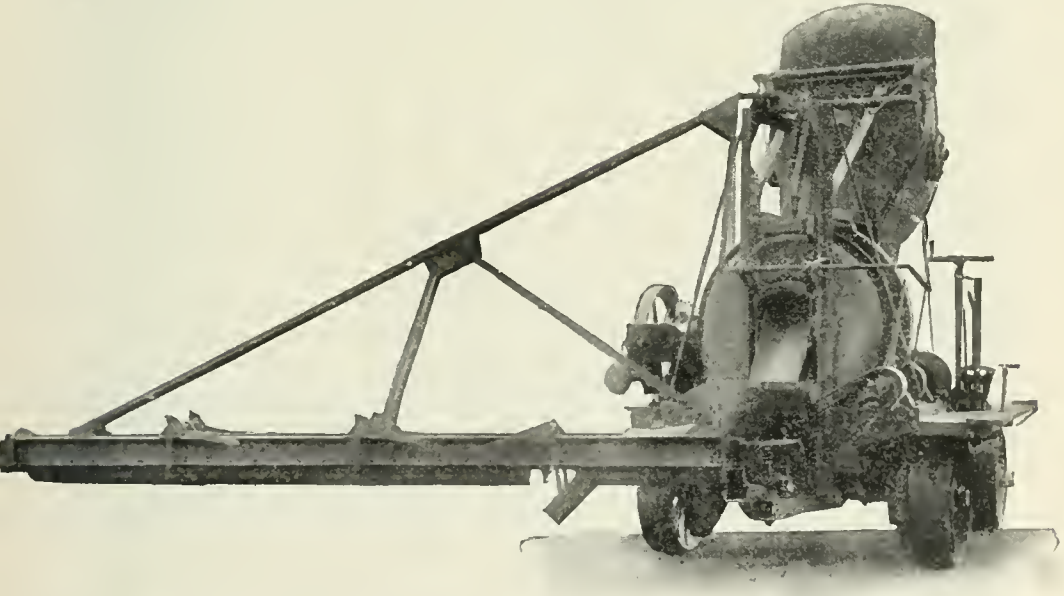
The other method of laying 2-course road consists of doing both the bottom and the top course with the one machine. In this case the mixer should be fitted with a device like the 16-foot mixing distributer supplied by the Marsh-Capron Mfg. Co. The method then is to lay the first course on 12 to 16 lineal feet of road. The reinforcing is placed immediately on top of the first course, and the mixer is then charged with the proper aggregates for the finishing course. The mixer then goes ahead 12 to 16 feet and another section is laid.

By this method the mixer is moved twice for each 25 feet of stone, or three times for stones 35 feet long between expansion joints. The yardage per day by the second method is not so great as where two mixers are used, but there is not such a big investment in equipment and not so many men are required, altho the cost per yard, as a rule, runs a little higher.

The second method has the advantage of the top course being laid before the first course has had any chance at all to set, and the results are generally satisfactory.

On country road work machines operated by gasoline engines are very popular, as the trouble of hauling a fuel and water supply is overcome. In country districts the water obtainable is very often not the best for boiler feed, and the gasoline engine, therefore, eliminates the dirty, scaly boiler, which would considerably reduce the efficiency of the outfit.

M—C PAVING MIXER, *showing distributing trough, discharging at four points along its length.*



The M-C rail-track paver is fitted with a 12-horse-power gasoline engine, which is not only sufficient to operate the machine while mixing, but is of considerable advantage when moving the machine, by means of its own traction gearing, on bad or hilly roads.

This tractive power is really the same as is found on heavy autotrucks and traction engines, and the machine is equipped with both a high and a low running gear. The low speed (one-half mile per hour) enables the operator to do the most effective work while laying concrete, moving only a few feet at a time, and also when traveling on bad roads, in climbing hills and in pulling out of difficult places on the highway. Shock absorbers prevent strain or danger, and the machine is further provided with a strong set of brakes, which makes it easy to move the mixer safely down grade.

No point has been overlooked in the traction end of the M-C paver. The wheels are extra heavy and of great strength and the frame is made in such sturdy manner that absolute rigidity is assured, no matter how much traction pull is required.

The high speed of the M-C paver is 1¾ miles per hour, and on good roads there is little delay in getting from one job to the next. The tractive power of this paver is such that no horses are ever needed to pull out of bad places or up a grade—a feature which most appeals to men who have been stuck on the way to work, and have lost much time and patience in getting started again.

A further feature of great value in the M-C rail-track paver is the differential gear which is furnished in the traction drive. This insures against strain of the machine, and is really so essential that the biggest and best posted contractors and engineers insist upon having their machines so equipped.

As the picture shows, the M-C paver is able to pull out and around obstacles easily and quickly. The steering is easy, and the operator has a clear view both ahead and to the rear. All levers are arranged at his fingers' ends, and there is no stretching or bending to make the days' work difficult. Handling the M. C. rail-track paver, the manufacturers claim, is so easy that engineers "scrap" for the job.

The M-C rail-track paver did the work on the job shown in the picture, altho under tremendous disadvantages, at the rate of 100 square yards per hour of concrete paving 7 inches thick. Old-time contractors and engineers who were there for the demonstration positively declared that they never had seen its equal, and further stated that the intersection itself was the best they had ever seen.

Stopping the Water Waste

"It is astonishing," said an engineer who had been investigating water consumption statistics, "that there is such a remarkable difference between the gallons per capita used in various cities. The maximum is 398 gallons, the average 121, the minimum 26. This illustrates the tremendous wastage, especially in locations where meters are not used. It has been found that by far the greatest per cent of loss is due to leaky faucets."

In this connection it is interesting to note the appearance on the market of a new washerless faucet which puts an end to leakage. This device is fitted with a conical valve bearing directly on a spherical seat. This gives a line contact which makes a tight joint, so it is not necessary to jam the handle in an endeavor to stop leakage. This new faucet should be of decided interest to owners of hotels, factories, or large establishments, where the water bill is a considerable item.

Householders also will find it a boon, as a leaky faucet not only means plumbers' bills, but also the disfigurement of bowls and tubs with an unsightly yellow stain.

This washerless faucet is in extensive use abroad and has been authorized by the London Water Board. The manufacturers, the H. W. Johns-Manville Co., New York, state that the American sales are mounting fast and making new records each month.

The Harris Municipal Garbage Incinerator and Steam Generator

Dr. J. B. Harris, the inventor of one of the most satisfactory smoke prevention furnaces in operation, has also invented and designed a line of high temperature destructors of city refuse, which can be built in single units of 10 tons to 25 tons capacity per 24 hours and in quadruple units up to any desired capacity, generating 100 to 1,000 h. p. per unit from special self-contained water-tube steam boilers and superheaters.

United States patents were allowed in March of this year and the Canadian patents were allowed and issued on March 24. Dr. Harris will sell the Canadian patents and would like to hear from interested parties at his office, 65 Life and Casualty Bldg., Nashville, Tenn.

New Lufkin Catalog

The Lufkin Rule Company announced the issuing of their new catalog, No. 9, now ready for distribution. Its 110 pages are devoted exclusively to measuring tapes and rules and it unquestionably is

the most complete catalog of such goods ever sent out. The various items thruout the book are well arranged and most comprehensively presented. The embossed cover is of strikingly original design, executed in the Lufkin stock label and box colors, tan and maroon. Special attention is invited to the fact that in addition to measuring tapes and steel rules, which lines the company has manufactured for the last twenty-five years, they now have ready for the market a complete line of folding boxwood, and flexible spring joint wood rules. Requests for copies of the new catalog will receive prompt attention and should be addressed either to the Lufkin Rule Company, home office at Saginaw, Mich., or New York office at 106 Lafayette street.

Montreal's Portable Asphalt Paving Plant

The accompanying photograph shows a Cummer one-car portable asphalt paving plant in operation in the city of Montreal, Quebec, Canada. This plant is turning out sheet asphalt at the rate of 2,000 yards of 2-inch top per day.

As the city of Montreal intends laying this year some miles of sheet asphalt, they are keeping this plant busy every minute.

Kissel-Kars as Fire Fighters

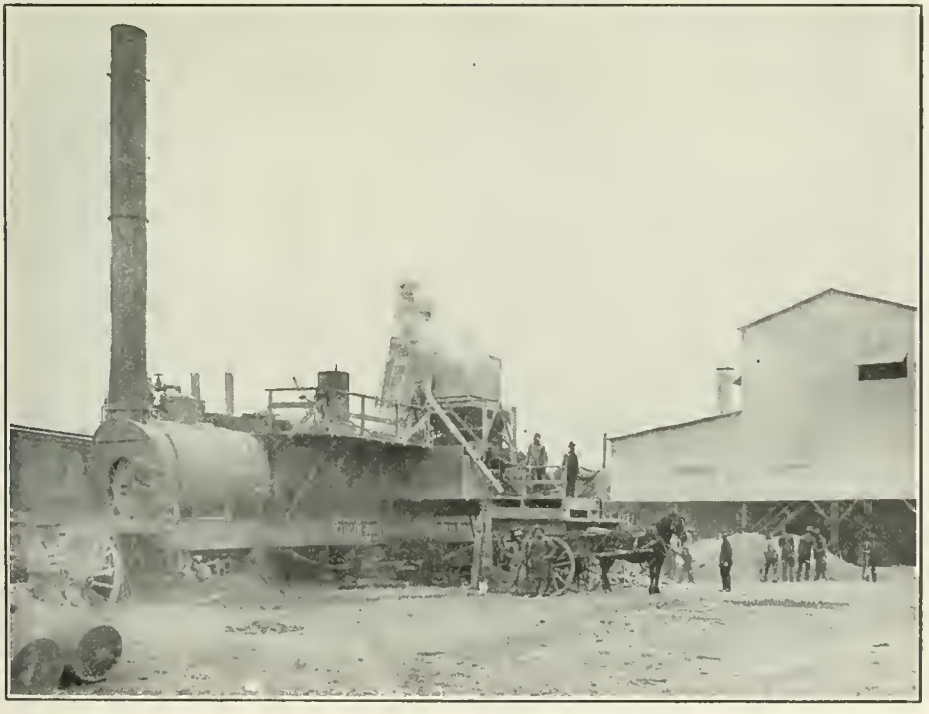
It did not require elaborate bookkeeping for the city of Marshalltown, Ia., to keep track of the operating expenses of a Kissel-Kar hose and chemical truck from April 1, 1912, to April 1, 1913. Here are the brief but eloquent figures:

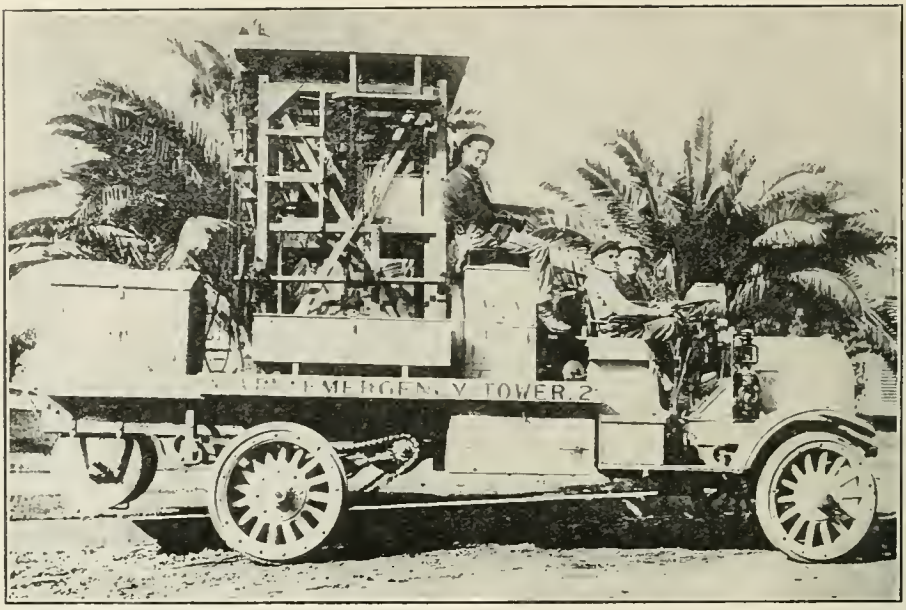
Tires	Nothing
Gasoline	$23.00
Repairs and replacements	.85
Lubricants	9.50
Total	$33.35

During the period covered, 107 alarms were answered, so that the cost of operation per fire was a little less than 32 cents. "In addition to the low cost of maintenance, the city has been able thru the adoption of the Kissel-Kar, to eliminate one man from the service," adds Chief I. T. Kirby.

On July 4th the city of Kankakee, Ill., made a very urgent run of six blocks with its Kissel-Kar hose and chemical truck and had water playing on the burning building in less than two minutes from the time it left the engine house. "The first essential in fighting a fire is to get there is the shortest possible time and the Kissel-Kar fulfills this aim in every respect," says Chief M. S. Baker.

From New Orleans, La., comes the story of a three-mile run with a Kissel-





KISSELKAR *used for emergency tower for street railway or electric light wire repair force.*

Kar hose truck, a large part of the distance being thru a congested part of the city. The truck had to halt three times and make four sharp and dangerous turns, yet had water playing inside of seven minutes from the receipt of the alarm.

"It is the truck that gets there and comes back," was the terse but adequate description given a Kissel-Kar hose and chemical by Chief Frank Brodheck, of Salina, Kansas, a veteran fire fighter who recently died, and the sentiment is echoed by his successor. Regarding this truck, Chief Brodheck further remarked: "When this car was tried out, it was put to every test. We made a run of 1.1 miles thru heavy gumbo in eight minutes. The best kind of a team could not have pulled thru at all."

For the initial tryout in Quincy, Mass., the department's hose and chemical Kissel-Kar was loaded with 21 men and sent over the hills known as the Wollaston section, comprising the hardest highways in the city. The test was entirely successful, and the truck in subsequent actual service, has lived up to its promise.

These are typical instances showing the maintenance economy and superior speed demonstrated in some of the cities where Kissel-Kar apparatus has been installed. Careful searching of the records fails to disclose a single complaint from any one of the thirty odd municipalities using Kissels in their fire departments. This is very remarkable when it is considered that there is no service to which a truck can be put where dependability and perfect performance are so essential as in fire fighting.

The South's Good Roads

That the South has not been getting due credit for its work in road improvement is indicated by a booklet just issued by the Barber Asphalt Paving Company, of Philadelphia. The first three or four pages contain 1914 photographs of Trinidad sheet asphalt pavements in Washington, D. C., Charleston, Louisville and New Orleans, that are from 20 to 30 years of age. These views are followed by a score of pictures of the types of roadway now being built in Southern states. Virginia, Maryland, North and South Carolina, Georgia, Tennessee, Alabama and Florida are among the states represented. Bermudez asphaltic concrete predominates, but there are many fine examples of asphaltic macadam or "penetration" roads and of highways resurfaced with liquid asphalt carpet coats. Instead of this advanced road construction being confined to big cities and their vicinity it is more or less of a surprise to find that small towns are laying the best types of asphaltic concrete roadways and not infrequently on a cement concrete base.

Hot Penetration Road Oiler

The motor truck has come into favorable use by the man who builds roads, having solved two of his greatest problems by giving him an efficient machine for construction work and a satisfactory medium for transporting his materials. The 5½-ton Hewitt "hot penetration" road oiler, which has just been built by the International Motor Company, New York, is such a machine.

This motor truck is equipped with road oiling apparatus, designed for applying binders to roads in course of construction. This machine should in no way be confused with a machine for laying dust. It is a purely constructive piece of machinery for building roads, conforming with the latest ideas employed in the construction of the new trunk highways.

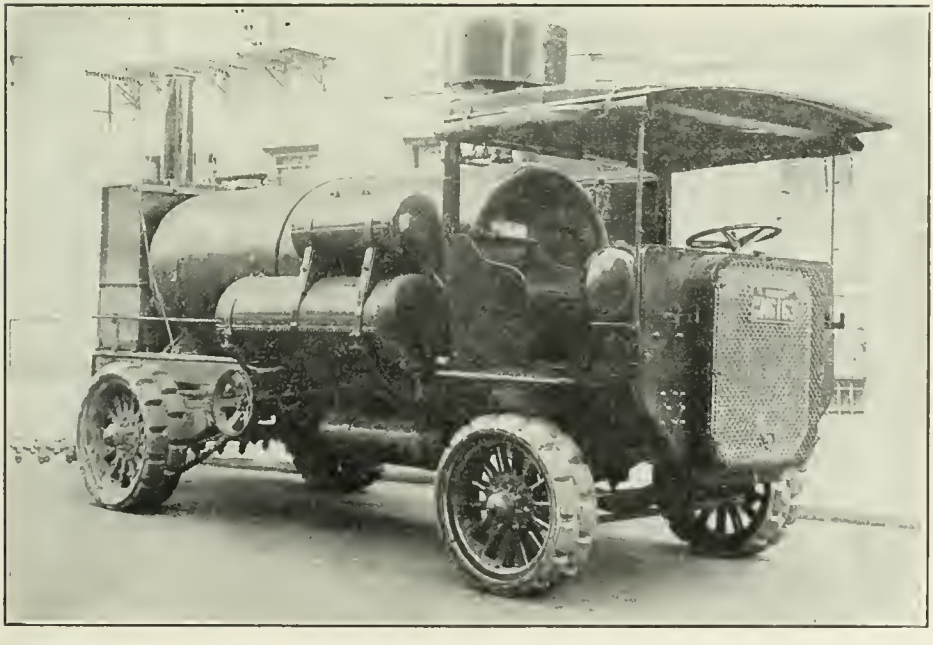
The rock construction of road built by this machine is very similar to the old-fashioned macadam. A permanent foundation is first laid, after which large crushed stone is applied according to the road specifications. The "hot road oiler" is then run over the road, applying a hot bituminous binder, which is forced onto the crushed stone under pressure. The hot oil fills up the interstices between the stones, holding them in place. As the binder hardens the stones are held more firmly in place, forming a solid mass of crushed stone and bituminous material. When the first course is finished, another layer of stone is rolled into place, the stones coming in contact with each other by the pressure of the steam roller; again a hot binder is applied by the "hot road oiler," filling up any crevices. In this way a solid road is obtained with no openings between the stones, and no moisture can get into the road and disturb its surface when it freezes, as is frequently the case in macadam roads. The stones are gripped in the bituminous binder and all spaces filled up, so that the stones cannot be picked out by automobile traffic. Of course, a road of this type has no dust.

This method of road construction is known as the "penetration method," and is one of the most economical ways of building a modern road.

The machine illustrated herewith is specially constructed for this class of work. It is a 5½-ton Hewitt truck, having sliding gear transmission with wide range of speed.

The large tank holds 750 gallons of binder. The binder in the tank is heated by coils of pipe in the tank, which coils are filled with steam. This steam is generated in the flash boiler at the rear of the truck. The boiler is fired by fuel oil which is carried in the upper cylindrical tank on the right-hand side of the truck. The steam from this boiler is also used to run a reciprocating "plunger type" air compressor, located on the left of the

HOT PENETRATION ROAD OILER, *with gasoline motor and pump.*



large tank near the front, just out of sight in the photograph. The air pressure forces the binder in the large tank onto the road. The lower cylindrical tank on the right-hand side of the truck carries the water for the boiler. The boiler is also provided with an air primer for starting the fire underneath the boiler.

Suitable arrangements have been provided for straining the binder when it is taken from the tank before reaching the distributing manifolds situated underneath the boiler at the end of the truck. They are seen in the photograph in part at the extreme left near the rear right wheel, and extend across the rear.

The operator is statioued at the rear of the truck, directly above the manifolds, so that he can control and regulate the application of the binder to the road. Provision is made for attaching a nozzle and hose to the distributing manifold and applying the oil locally by hand.

It can readily be seen that a full range is reached for the application of the binder, by varying the air pressure on the tank, by opening and closing the manifold nozzles, by varying the temperature at which the binder is applied, and by running the truck at different speeds.

Binder can be applied at the rate of from ¼ gallon per square yard to as much as 2 gallons per square yard.

This machine is one of the various types that the Standard Oil Company have in service in various parts of the country, and which they find of the utmost service in road work.

The Knox Motors Company is the Title of the Reorganization

By a decision just handed down by Judge Morton in the United States District Court of Massachusetts, the last question in the transfer of the old Knox Automobile Company to the new Knox Motors Company, of Springfield, Mass., has been settled. Judge Morton has confirmed the sale of the entire plant and property to E. O. Sutton, of Springfield, who is now treasurer of the new company.

Pending this confirmation of the sale, tentative plans for the conduct and wise extension of the Knox business had been formed and were partly under way, but with the receipt of news that the sale had been confirmed the execution of these plans was begun with a rush. H. G. Fisk, treasurer of the Fisk Rubber Company, and one of the best known men in the motor car industry, had already been elected president of the Knox Motors Company.

The Knox Company already had the nucleus of a dealers' organization thru branches in New York, Boston, Chicago and Kansas City, and these will be continued and their organization not only will be enlarged, but their scope increased widely.

The production department had already partially completed the thoro systematizing of the factory and the effect of Judge Morton's confirmation of the sale is to make possible the unification of the entire Knox organization, both producing and selling, in a way that has not been practicable heretofore.

Immediate results of the confirmation order were seen in the issuing of production orders for a number of Knox-Martin tractors and a quantity of fire apparatus of the latest design.

The latest Knox model touring cars were coming thru the factory at the time and an added impetus was given their production.

One of the first indications of the result of the formation of the Knox Motors Company has come in the applications of high grade dealers for allotments of territory and Knox products. The opportunity to handle Knox-Martin tractors, which have formed a large part of the production of the Knox Company, has proved a great incentive to dealers.

Semi-Portable Bituminous Mixing Plant

With the increasing use of bituminous macadam and the demand for closer economy and exact methods in asphalt road and street construction, the need has been emphasized for a relatively small, compact mixing plant of moderate first cost and minimum expense for maintenance. Such a plant must be suitable for various mixtures and sufficiently portable to overcome the loss entailed in excessively long hauls of the finished mixtures.

To meet these conditions the plant here described has been designed and built at the Iroquois works of the Barber Asphalt Paving Company.

The plant consists of four units—portable boiler and engine, portable single-drum drier, portable melting tank and mixing tower—which are so arranged that the plant in its entirety can readily be moved and reassembled.

The portable boiler and engine, selected for the particular duty to be performed, have power largely in excess of the actual requirements of the plant, thus insuring certainty of operation and permitting of flexibility in case it is found desirable to increase the normal capacity of the plant. The boiler is of 60-h.p. locomotive type with a 55-h.p. horizontal engine placed over the boiler shell. The entire unit is mounted on four substantial wheels.

The melting kettle has a capacity of 1,556 gallons and is a self-contained unit

with a refractory lined fire unit, fire and ashpit doors, and arranged for steam or air agitation, as the purchaser may prefer. This unit is mounted on three 6-in. heavy section I-beams for portability.

The single drum drier is of the "Iroquois" standard type, containing every refinement suggested by a quarter century's experience in the asphalt paving industry. The drum proper is 40 inches in diameter and 20 feet long, complete with fire brick and asbestos lined steel setting, firing chamber, double rain roof, elevators, etc. It is a complete self-contained unit mounted on substantial steel axles and wheels.

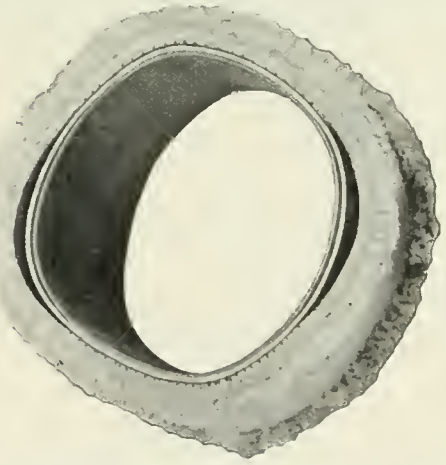
The mixing tower is constructed of four main columns, consisting of heavy section steel I-beams carrying the necessary platforms, all securely braced with tie rods and turnbuckles. To facilitate dismantling and re-erecting, the several members are bolted together. The mixing tower unit is fully equipped with a standard 9-cubic-foot "Iroquois" steam-jacketed mixer, with two sets of shafts and teeth, enabling the purchaser to produce any one of the several mixtures likely to be called for—binder, bituminous macadam, asphaltic concrete or standard sheet asphalt surface mixture. A two-compartment sand bin of total capacity of 218 cubic feet is supported between the upper legs of the tower. A rotary screen and cradle are mounted directly over the sand bin, and are equipped with jacket for the proper separation of the mineral aggregate; the screen can readily be jacketed to meet any modification in the mineral aggregate. The tower carries a dust collector of improved design and is so located that the dust collected is delivered above the line of the top of the mixer, making it available for use as "filler." The necessary accessories, such as weighing box and scale for mineral aggregate, traveler, bucket and scale for the bituminous material, power fan, link-belt elevators, etc., are parts of this unit.

Capacity. Those familiar with the production of bituminous surface mixture fully appreciate that the capacity of a mixing plant is limited by (a) the maximum capacity of the mixer employed and (b) the capacity of the dryer. In the plant here described the dryer has a capacity for handling a scientifically graded cold sand of the composition required for a standard sheet asphalt surface mixture, containing not more than five per cent of moisture, at air temperature 77° F., and delivering same to the conveyors at 350° F., at the rate of six tons (12,000 pounds) per hour of continuous operation. The mixer, however, has a capacity of more than double the capacity of the dryer, making it possible to double the capacity of the plant by installing an additional dryer unit and kettle unit. A superficial square yard of standard sheet asphalt surface mixture, 2 inches in thickness, may safely be assumed to weigh 200 pounds. The drum capacity is based on 160 pounds of sand (alone) included in a square yard of surface mixture consisting of sand, filler and asphalt cement. Six tons (12,000 pounds) of sand is the equivalent of 75 square yards per hour or 750 square yards of 2 inch thick surface per day of 10 hours. On coarser aggregates intended for bituminous macadam or asphalt concrete, the drum capacity will materially increase.

The plant as designed contemplates the use of steam for agitating the molten bituminous material. If desired, a complete air installation can be substituted. The first of these plants to be built has been purchased by the city of Springfield, Mass.

Hose That Will Not Crack

A constant source of injury to fire-hose is the compression of the rubber lining at the lines of the folds when the hose is rolled up or folded in place for storage.



HOSE *that will not crack. Note lining free from fabric on sides where fold comes and firmly attached where hose flattens in storage.*

The bi-lateral hose obviates this difficulty by leaving a band of the rubber lining about the area of the fold free from the fabric of the hose, cementing the lining to the fabric on the areas flattened in the folding. Humps at the ends of the flat sides relieve the pressure on the free end areas, thus preventing the flattening

down and creasing at the lines of folding. This results in making the life of the hose depend on the regular life of the lining and not on its ability to stand the misuse of the material in the folding, an obvious source of economy. The hose is put on the market by the Bi-Lateral Hose Co., 326 W. Madison St., Chicago, Ill., and is manufactured by the B. F. Goodrich Co.

Goodrich Guides Motorists Over 300,000 Miles of Roads

From Cape Cod to the Golden Gate and from Michigan to Florida, the B. F. Goodrich Company's Touring Bureau has covered the country with sign-posts to guide the motorist on his way.

Not only that, but the Goodrich Touring Bureau has mapped almost every good road in the country and put its vast collection of data, relating to routes and touring information, in its famous Route Books, which we are now ready to distribute free.

Year by year this service, the only one of its kind in the world, has been extended till now, 1914, will see 300,000 miles of the best touring routes in this country, Canada and Europe, plotted so that motorists can go anywhere they want to and have a safe and sure guide all the way, either with a Route Book for the section or by the road markers, which have been set up to the number of 45,000 or more.

There are also 'road logs' of different tours and routes connecting the large centers of population throughout the United States and Canada; 'Rules of the Road,' crammed full of information about driving, care of car and tires, and other data; and the 'Memory Book of Motor

GOODRICH
BOSTON 34 PLYMOUTH 9
QUINCY 25 KINGSTON 1
GUIDE
A Memory Book of Motor Yesterdays
Rules of the Road
and Saving Hints to the Man Behind the Wheel

Yesterdays,' in which the tourist can record his trip records, odometer readings, speedometer readings and character of hotels and garages found on the way.

All these books can be obtained by motorists at their nearest Goodrich branch, or by addressing The B. F. Goodrich Company, Akron, Ohio.

Weight of Jacksonville, Fla., Ladder Truck

In the advertisement of the Goodrich wireless truck tires on advertising page 11 of the May number of MUNICIPAL ENGINEERING, appeared a photograph of the motor ladder truck used by the fire department of the city of Jacksonville, Fla., with the statement that it weighed 18 tons. This is an obvious error and the weight is actually about 8 tons.

Steel Cells for Jails and Prisons

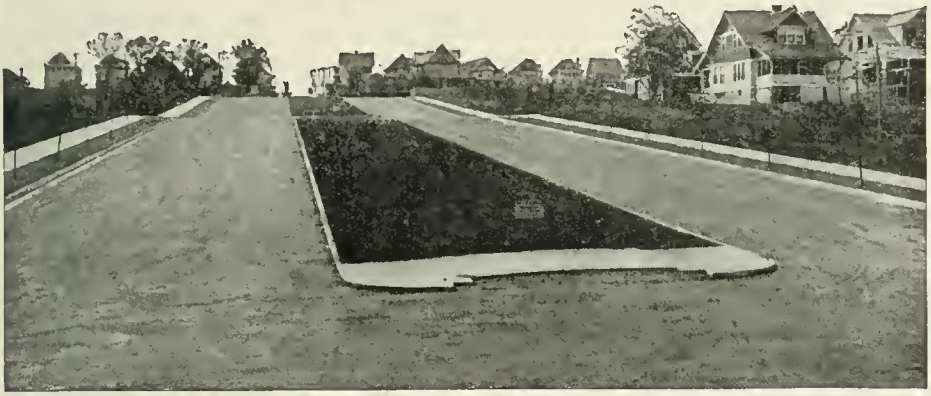
Two important steel jail cell contracts have been recently awarded to the Van Dorn Iron Works Co., of Cleveland, Ohio, who are specialists in steel prison cell constructions, one at Bakersfield, Cal., for the new Kern county jail and the other at Charlotte, N. C., for the new Mecklenburg county jail.

These contracts were placed with the Van Dorn Iron Works Co., thru the merits of its special tool-proof steel material, special sanitary interlocking grating construction and the special keyless locking device for sliding cell doors, which features are included in other jails of their production.

Another important jail recently completed by this company is the Clarke county jail at Athens, Ga.

Tarvia

Preserves Roads
Prevents Dust



Esplanade, Brighton Ave. to Abbington Blvd., Kansas City, Mo. Constructed with "Tarvia X", Spring 1912.

How tarviated roads reduce upkeep—

ORDINARY macadam is surfaced with fine screening, the durability of which is necessarily slight. These particles are readily dislodged by traffic and are constantly shifting and rubbing, forming dust which is washed or blown away.

After a little time this surface disappears, exposing the lower layers of coarser stone. The large stone of the lower courses, thus exposed, shifts under the weight of traffic and the road then begins to ravel hopelessly and requires an expensive renewal.

These larger stones, if they could be held in position, are capable of giving more wear than the fine stone of the surface.

One of the many economies of the Tarvia treatment is that it is so efficient a binder that it permits the use of large stone clear up to the wearing surface, screening being used merely to even up the surface for the sake of smoothness.

In this matrix of Tarvia, the larger stones take the direct wear of traffic. They cannot shift, and the road grows smoother with use and eventually becomes a mosaic of great durability. Very little care or renewal work is needed on such a road. It will stand heavy traffic without producing dust or mud. It is clean and attractive at all seasons.

If you are interested in the good roads proposition, write for the free booklet covering the Tarvia treatment.

BARRETT MANUFACTURING COMPANY

New York Cbicago Philadelphia Boston St. Louis Kansas City Cleveland
Cincinnati Minneapolis Pittsburgh Seattle Birmingham

THE PATERSON MFG. CO., Limited: Montreal, Toronto, Winnipeg, Vancouver, St. John, N. B., Halifax, N. S., Sydney, N. S.

TRADE B MARK

Architects, engineers and county, city and state officials contemplating work of this kind should have the catalog issued by this company, as it contains valuable information.

Condition of New Jersey Roads

A recent survey of the condition of roads in Essex, Union, Morris, Passaic and Hudson counties in the neighborhood of Newark, N. J., showed in general an excellent condition of the roads, but there were many places in which careful and intelligent repair is much needed. A long list of places needing repair is given, which shows that even in this district of good roads, some of them built twenty years ago or more, the methods of repair are not all that could be desired.

Most of the roads are of macadam, and much of this macadam is worn down to the broken stone of the foundation and will need repair at once or complete reconstruction after another season or two of neglect. Some of these areas are being repaired by the process of dumping broken stone and letting the traffic compact it, the road roller not being seen frequently. This process produces a poor road at a very high repair cost. In some places soil is mixed with the stone as a binder and the results will be better, tho still not good.

In the county of Essex, 15 of the 166 miles of county road require general overhauling and only a small portion of the remainder requires even minor repairs.

The shoulders along some of the bituminous roadways require filling with earth or cinders, the hard surface being too narrow for passage of vehicles by each other, except with great care, without running partly on the soft shoulder.

Most of the roads, particularly in Essex county, are reported to be in excellent condition.

Trade Notes

It doesn't require much imagiuation to see that the retail tire business is fast becoming the big end of the automobile business. Soon the profits from the sale of tires for old cars will exceed the profits from the sale of new cars. They do now in some places. That's why progressive dealers everywhere are taking up the sale of tires seriously, and the Goodyear Tire and Rubber Co., of Akron, O., are securing its share of the business by their modern methods of selling added to the high quality of their product.

The Peebles Paving Brick Company, which has two plants at Portsmouth, O., has purchased a plant at Firebrick, Ky., and will manufacture the Dixie brand of Dunn wire-cut-lug brick.

The Duluth office of the H. W. Johns-Manville Co. has moved to larger quarters at No. 327 W. First street, in order to take care of its increased business. The new office is on the ground floor, with windows for the display of J-M asbestos roofing, pipe coverings, packings, sanitary specialties, auto accessories and other products of this company's well known and varied lines.

George Griffiths, 418 Odd Fellows Bldg., St. Louis, Mo., and C. A. Cleaver, 122½ Main street, Houston, Texas, have recently taken the agencies in their respective territories for the chain belt concrete mixer, chain belt paver, the chain belt line of distributing spouts and towers and other concrete machinery manufactured by the Chain Belt Company, Milwaukee, Wis.

"The Buffalo Foundry & Machine Co., of Buffalo, N. Y., announce that they have terminated the arrangement whereby H. E. Jacoby has been representing them in New York City and vicinity. They are now handling direct all inquiries covering vacuum apparatus, castings, patterns, and machine work."

Trade Publications

Section A of Catalog 110 of the Link-Belt Co., Chicago, Ill., is devoted to the original Ewart detachable link-helt and sprocket wheels, invented in 1873 and the first presented to the public. The Link-Belt Co. are still the largest manufacturers of this type of belt. All the illustrations in the catalog are from photographs and show the belt and attachments as they are actually made and used.

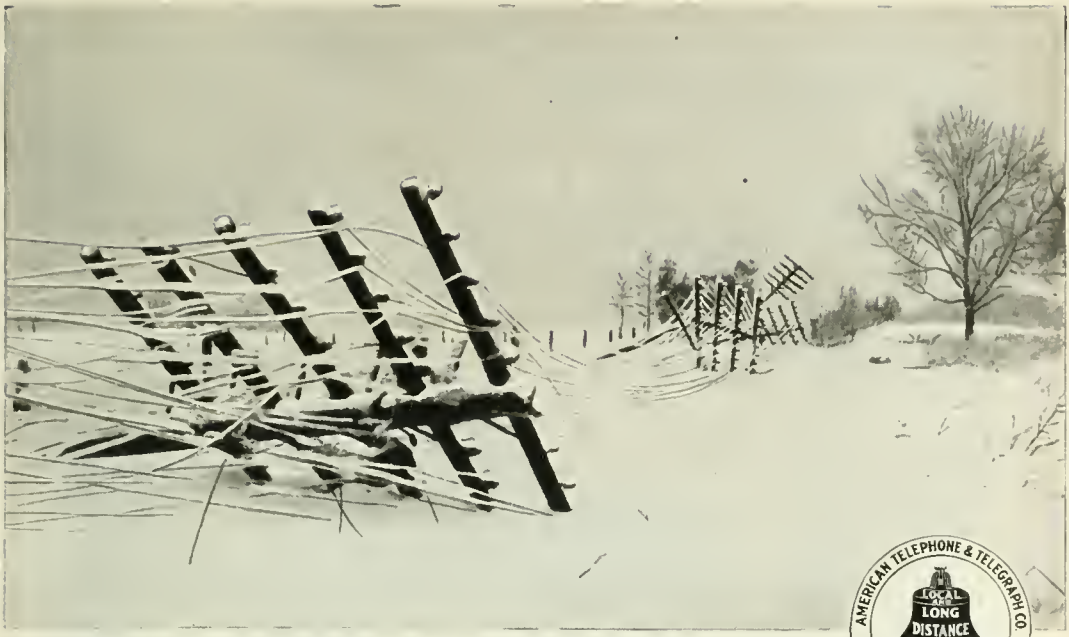
The Kindling squeegee and the Kindling sand spreader are lfuly described in a new catalog issued by The Kindling Machinery Co., Milwaukee, Wis., which gives the results of tests and of regular operation of the machines in New York and Washington.

The latest applications of metal lath to building construction and the results of using less fireproof methods of construction are shown in the June monthly bulletin of the Northwestern Expanded Metal Co., 37 W. Van Buren St., Chicago, Ill.

Concrete Roads is the title of a new series of bulletins issued by the Universal Portland Cement Co.

Artistic design in reinforced concrete bridges is illustrated by contrasting views in a circular issued by D. B. Luten, of Indianapolis, Ind.

Wagon and truck loaders for handling coal, coke, stone, sand and similar loose materials from storage are fully described in Book No. 190 of the Link Belt Company, of Philadelphia, Chicago and Indianapolis.



The Telephone Emergency

THE stoutest telephone line cannot stand against such a storm as that which swept the Middle Atlantic coast early in the year. Poles were broken off like wooden toothpicks, and wires were left useless in a tangled skein.

It cost the telephone company over a million dollars to repair that damage, an item to be remembered when we talk about how cheaply telephone service may be given.

More than half of the wire mileage of the Bell System is underground out of the way of storms. The expense of underground conduits and cables is warranted for the important trunk lines with numerous wires and for the lines in the congested districts which serve a large number of people.

But for the suburban and rural lines reaching a scattered population and doing a small business in a large area, it is impracticable to dig trenches, build conduits and lay cables in order that each individual wire may be underground.

More important is the problem of service. Overhead wires are necessary for talking a very long distance. It is impossible to talk more than a limited distance underground, although Bell engineers are making a world's record for underground communication.

Parallel to the underground there must also be overhead wires for the long haul, in order that the Bell System may give service universally between distant parts of the country.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY

AND ASSOCIATED COMPANIES

One Policy *One System* *Universal Service*

Dull's Tubular Washer

This machine, which was placed on the market last year, has excited so much comment and given such excellent results that a description of the machine should be of interest.

It was designed by the Raymond W. Dull Company, Chicago, primarily to wash sand and gravel for concrete purposes and it answered this purpose so well that more difficult materials, such as filter sands, foundry sand and materials containing coal dust have been washed.

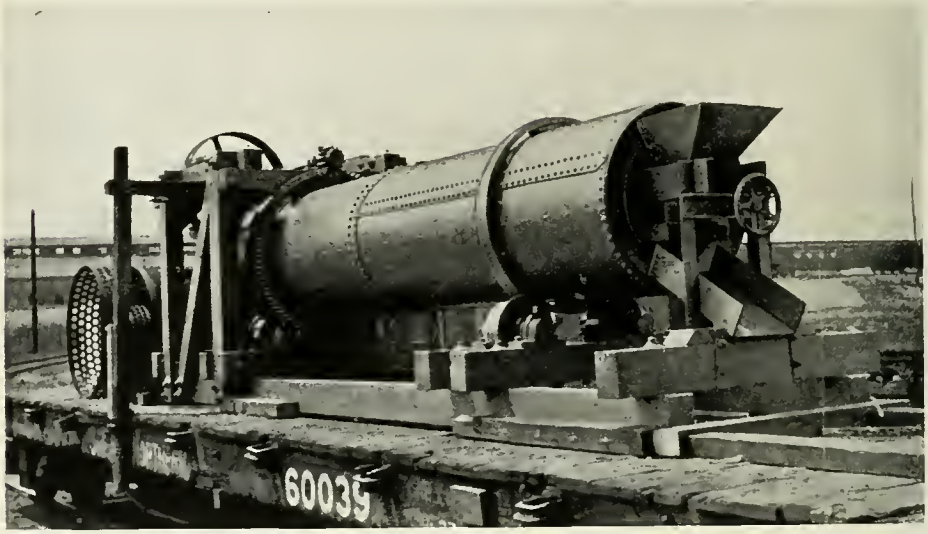
A recent experiment for a large steel foundry showed surprising results. The waste sand, which contained a fire clay binder including molasses, flour, etc., was washed clean. The sand which was washed was put thru a series of test screens and a comparison made with fresh foundry sand showed that the percentages were almost identical with the grading of the fresh sand. The refuse also was very critically examined by experts, who pronounced that it contained practically no good material.

The operation of the washer is very simple. The machine consists of a cylinder which revolves on chilled trunnion wheels. The inside of the cylinder has several lifting angles running the total length of the shell. The rotation of the cylinder causes the lifting angles to pick up the material in the cylinder and carry it up to the top and then discharge over a series of fixed shelves. The fall of the material over the shelves scours it and as they are arranged so that the lower series is set ahead of the upper series of shelves the material progresses forward as it falls.

The washing water flows in the opposite direction from the travel of the material, which insures that the material will be discharged where the water is cleanest. The cylinder has closed ends with center openings and this retains considerable water in the machine to do the washing.

The progress of the material thru the machine is governed by moving the lower series of steps. By increasing the number of falls of the material the most difficult materials can be washed. The machines are made in four different sizes, ranging from 30 inches in diameter and 8 feet long, to 60 inches diameter and 20 feet long. They are constructed of heavy boiler plate and have steel tires and trunnion wheels with chilled tread.

The machines are manufactured and sold by the Raymond W. Dull Company, 1910-1912 Conway Building, Chicago, Ill., who are specialists in sand and gravel handling machinery.



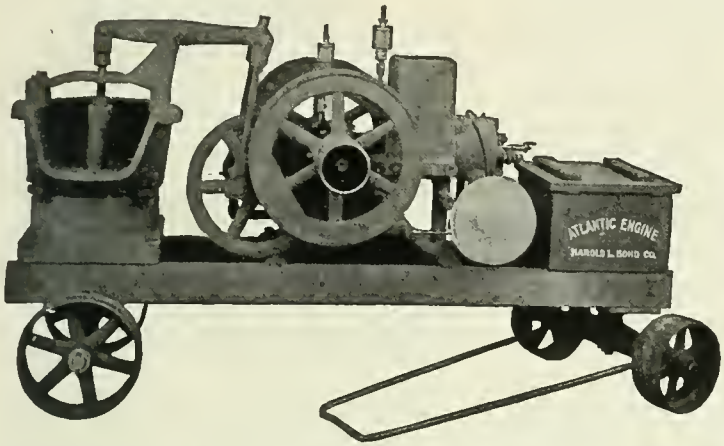
DULL'S *tubular washer for washing sand and gravel. Note that water enters and the washed material leaves the washer at the upper end.*

Study these Improvements

They increase the Efficiency, Durability and Capacity of the

ATLANTIC DIAPHRAGM PUMP

and they are *exclusive features.*



New 4-inch Atlantic Diaphragm Trench Pump.

List Price, $165.00.

OBSERVE THE

Special Top Head
Rigid Fulcrum
Positive Piston Stroke
Improved Waterway

Lost Motion Eliminated

Valve seat is machined, making a much more dependable closing of valve. Water inlet is changed in direction to decrease friction.

It is a well-known fact that the average Diaphragm Pump is weak in parts, inefficient and subject to excessive wear in certain places.

Our object has been to overcome these faults and **make the Pump the equal of the Engine** in efficiency and durability. We now have a Pump and Engine which will stand up on the job, and we back our outfit by a year's guarantee that means something.

OUR FREE TRIAL OFFER

BACKED BY A FULL YEAR'S GUARANTEE OF EVERY OUTFIT.

We will send an ATLANTIC PUMPING ENGINE to any responsible party with the privilege of five days' trial. If it is not exactly as represented and superior to other equipment of the same kind, it may be returned to us and we will pay freight both ways.

Telegraph or write for net prices and full description.

HAROLD L. BOND COMPANY

383 M Atlantic Ave., BOSTON, MASS.

Manufacturers of

Ross Concrete Spade, Andrews' Concrete Tamper, Safety Trench Braces, Felton's Sewer and Concrete Rods, Pearl Brand Suction Hose.

CONTRACTING NEWS

AUTOMOBILES.

FIRE APPARATUS.

Benton, Ill.—Bond issue of $15,000 voted for creating city fire department. S. B. Espy, mayor.

Cleveland, O.—Ordinance authorizing special election for issuance of $300,000 bonds for addition of ten more companies to fire department, proposed by Geo. Lomitz, chairman of fire department advisory board. A. A. Benesch, public safety director.

Duluth, Minn.—Entire fire department will be motorized; police department will also be equipped with small automobile. Jos. Randall, fire chief.

Galveston, Tex.—Purchase of an automobile ambulance for city is recommended by Mayor Lewis Fisher.

Girard, Ohio—Installation of an electrically operated fire alarm system and purchase of auto truck and other equipment is being considered by city council. Thos. G. Blackstone, mayor.

Lorain, Ohio—Ordinance for purchase of a second auto aerial ladder truck is being considered. J. J. Pollock, mayor.

Marion, Ohio—Bond issue of $10,000 voted by council for purchase of automobile engine pump; ordinance adopted for issuing $5,000 bonds to pay difference in changing auto chemical wagon for an auto fire engine pump. Don E. J. Brockett, mayor.

San Antonio, Texas—City purchasing agent instructed by council to advertise for one motor-driven police patrol wagon, cost $3,500, and two automobiles for police and detective departments at $1,500. Phil Wright, fire chief.

BRIDGES.

BIDS REQUESTED.

Cleveland, Ohio—July 22, until 10 a. m., for reinforced concrete arch bridge on Pearl road across Big Creek Valley. Certified check, $10,000. E. G. Krause, clerk, board of Cuyahoga county comrs.

Phoenix, Ariz.—July 13, until noon, for 22-foot reinforced concrete bridge over Salt River Valley Canal on Phoenix-Temple highway; also 25-foot reinforced concrete bridge over Maricopa canal on same road. Jas. Miller, Jr., clerk, Maricopa county supervisors.

Toledo, Ohio—July 17, until 10 a. m., for bridge and abutments on Wood street over Miami and Erie canal in Waterville Village, and bridge and abutments on Canal street in Maumee. Certified check, $500.00. Chas. J. Sanzenbacher, auditor Lucas county.

CONTRACTS AWARDED.

Chillicothe, Ohio—To Oather M. Junk, Chillicothe, substructure of Main street bridge over Scioto river at $24,505; to Capital Construction Co., Columbus, O., superstructure of same at $44,625; to Wylie & Renick, Circleville, O., substructure of Higby bridge, Jefferson and Franklin townships, and superstructure of same to E. M. Scully, Columbus, O.

Freehold, N. J.—To Owen J. Melee, Long Branch, N. J., reconstruction of bridge over Parker's creek at $17,900.

Indianapolis, Ind.—To Central States Bridge Co., 601 Beecher street, city, superstructure of Minnesota street bridge over Pleasant Run, at $7,385.

Los Angeles, Cal.—To Mersereau Bridge & Construction Co., 471 Pacific Electric Bldg., city, steel bridge over Calf Canyon at $13,146, and steel bridge over Old Creek crossing at $12,960.

Paso Robles, Cal.—To Gottleiben Bros., San Francisco, steel bridge at $44,328.

BUILDINGS.

BIDS REQUESTED.

Ben Davis, Ind.—July 10, until 2:30 p. m., for two-room addition to school house in Wayne township, Marion county. G. D. Harding, trustee.

Cincinnati, Ohio—Until September 1, for construction of Hamilton county's courthouse building. Estimated cost $2,500,000. Specifications may be obtained by depositing check for $250.00 with Architects Rankin, Kellog & Crane. For further information address New Courthouse Building Commission.

Macedonia, Ohio—July 17, until noon, for brick school building. David Grimm, clerk, board of education.

Medora, Ind.—July 18, until 9 a. m., for remodeling school building in Carr township, Jackson county. Joel B. Henderson, trustee.

Springfield, Ill.—July 20, until 3 p. m., for erection of following buildings: One Morgue and Laboratory; one Receiving Cottage for Men; one Amusement Hall, Peoria State Hospital, South Bartonville, Ill., and one Horse Barn at Soldiers Home at Normal, Ill. Frank Dibelka, state architect, 29 S. LaSalle street, Chicago.

Wheatfield, Ind.—July 18, until 2 p. m., for an addition and alterations to high school building, Wheatfield township, Jasper county. A. S. Keene, township trustee.

CONTRACTS AWARDED.

Belton, Texas—To Hart & Gaught, Ft. Worth, brick high school building, at $39,545.

Breckville, Ohio—To Rowe & Giles, Chagrin Falls, school building, at $23,523.

Chattanooga, Tenn.—To D. F. Brandon, city, remodeling police headquarters for marketing place, at $13,050.

East Orange, N. J.—To Tobin Mason & Building Co., city, six-room addition to Franklin school building, at $32,945.

Ely, Minn.—To Boyd Construction Co., Germania Life Bldg., St. Paul, 2-story and basement school building, at $125,000.

Knox, Ind.—To Peter Holen & Son, Grovertown, Ind., 2-story brick addition to high school building, at $4,185.

Lestershire, N. Y.—To John Schultie, city, school building, at $71,000.

Peru, Ind.—To Chas. Clifton, city, school building, at $17,661.65.

Rushville, Ind.—To Steven Purcell, Rochester, Ind., school building, at $41,990.

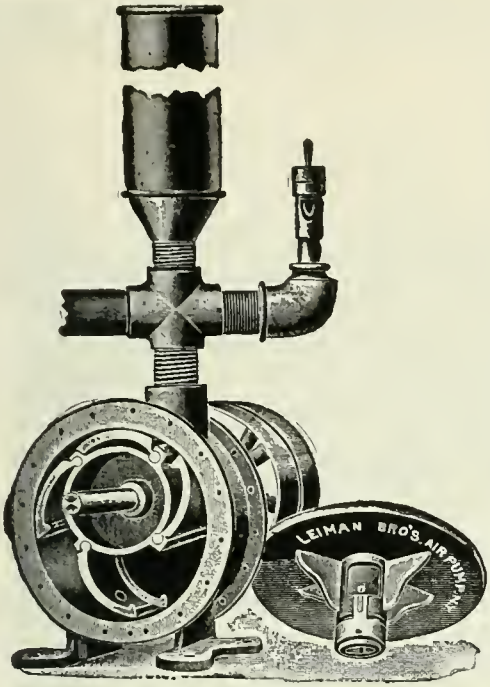
Topeka, Kans.—To Lundgren & Carlson, Topeka, addition to high school building, at $45,369.

Waterford, Ind.—To L. A. Kunkel, Michigan City, Coolspring township school building, at $5,500.

Wilmington, N. C.—To W. P. Rose, Goldsboro, Hemenway school building, at $33,550.

CONTEMPLATED WORK.

Bentonville, Ark.—Plans being prepared by Stevens & Nelson, architects, New Orleans, La., for Benton county courthouse. Esti-



Vocational training is receiving the attention of educators everywhere. To receive the proper training for a life's work is a very serious business, and it is right that the best tools and appliances, as well as the latest methods, should be found in all trade and vocational schools.

LEIMAN BROS. ROTARY POSITIVE HIGH PRESSURE

BLOWERS

will be found in all first-class schools of this kind because they are the blowers that give efficient service for creating high and steady heats for melting metals, soldering, brazing, annealing, hardening, forging, sand blasting, agitating plating solutions. Better than ordinary fan blowers because they drive the air along the pipes in a positive stream, and running at slow speed they require very little power. *Get Catalogue No. 100.*

We also supply complete motor driven outfits for cutting and polishing quartz specimens and gem stones; drilling, polishing dust collecting, turning, sand blasting, rolling brass, copper, gold, silver, etc. *Get our complete Catalogue.*

LEIMAN BROS.

62 AL John Street NEW YORK CITY.

mated cost, $175,000. H. C. Smith, county judge.

Butte, Mont.—Issuance of $150,000 bonds for school buildings will be voted August 5. W. I. Willis, city clerk.

Canton, Ga.—Bond issues of $25,000 and $5,000 voted for erection of school building and city hall.

Greenville, S. C.—Erection of Municipal Hospital being planned. Bond issue, $40,000.

Hamtramck, Mich.—Plans being prepared for 2-story and basement school building for School District No. 8, by Geo. A. Hass, architect, 307 Moffat Bldg., Detroit, Mich. Estimated cost, $7,000.

Joplin, Mo.—Construction of an annex at Municipal Orphanage proposed. Estimated cost, $5,000. Hugh McIndoe, mayor.

Myerstown, Pa.—Plans for 2-story stone high school to cost $50,000 being prepared by Edward Z. Scholl, 31 North 6th street.

Poland, Ind.—Construction of grade school building to be considered at mass meeting held July 11.

Salt Lake City, Utah—$70,000 appropriated for erection of 6-room addition to summer school and for completing first unit of Ensign school. Address board of education.

Union Grove, Wis.—Construction of Union high school for Racine and Kenosha counties in this village at cost of $13,000 is being considered. G. J. Zimmerman, Jr., county superintendent of schools.

LIGHTING.

CONTRACTS AWARDED.

Livingston, Mont.—To Beley Construction Co., Livingston, installation of lighting system, at $14,944.

Mangum, Okla.—Resolution adopted cancelling a 25-year contract with Mangum Electric Co. for street lighting. Installation of Municipal Light and Ice plant is being considered. Mr. Border, mayor.

Melvin, Ill.—To Central Illinois Utilities Co., 22 street lamps of 60. c. p., at $30.00 per year; contract is for 10 years.

Monticello, Ind.—To M. J. Hoffman, city, system of boulevard ornamental lights, at $2,356.92.

Newport Beach, Cal.—To F. O. Engstrum Co., 5th and Seaton streets, Los Angeles, installation of ornamental lighting system, at $14,000.

ROADS AND PAVEMENTS.

BIDS REQUESTED.

Bowling Green, Ohio—July 14, until 1 p. m., for grading, draining and macadamizing and applying tar and bituminous binders and constructing earth road on various roads in Wood county. Certified check, $500.00. C. E. Stinebaugh, auditor.

Cameron, Texas—Until July 15, for constructing macadam, gravel and concrete highways in Road District No. 2, Milam county; $150,000 available for work. J. C. Field Engineering Co., engineers, Field Bldg., Dennison, Texas.

Edon, Ohio—July 24, until noon, for paving Michigan street and Indiana streett. Certified check, $4,000, made payable to H. L. Eyster, village clerk. Geo. Champe, civil engineer, 610 Nasby Bldg., Toledo, O.

Wapello, Iowa—July 15, until 11 a. m., for 8,003 cubic yards road grading on Wapello-Newport county road; 8,424 cubic yards on Wapello-Columbus city road, and 19,300 cubic yards on Newport-Morning Sun road. Certified check, 5 per cent. of bid, made payable to H. W. Baker, county auditor.

Wauseon, Ohio—July 14, until 1 p. m., for joint county road improvements Nos. 17 and 11; lengths, 6 miles and 2 miles respectively. Certified check, $500.00, made payable to W. W. Ackerman, auditor, Fulton county.

CONTRACTS AWARDED.

Angola, Ind.—To H. L. Janney Co., Muncie, Ind., paving of West Maumee street, with brick, at $28,698.

Baltimore, Md.—To Baltimore Asphalt Block & Tile Co., city, resurfacing Riverside avenue with sheet asphalt, at $7,635, and paving of Eighth street with sheet asphalt, at $37,507.52; to American Paving Co., city, paving 14 streets with sheet asphalt, at $64,535.

Chattanooga, Tenn.—To West Construction Co., city, vitrified brick paving on Chestnut street, at $15,444.10, and on 26th street, at $6,633.90; to Key-Arnold Co., city, vitrified brick paving on Main street, at $14,181.95.

Dixon, Ill.—To Rink & Schnell, brick pavement on Central avenue, at $20,381.43; to J. W. Kelly, city, concrete pavement on Seventh street and Chicago road, at $9,751.01; to Gund & Graham, Freeport, brick paving on East Second street and Crawford avenue, at $18,536.27; to Chas. E. Hughes, Rockford, brick paving on East Fellows street, at $12,167.79; to Duffey & Hubbard, city, macadam on East Everettt street, East Boyd street, and North Jefferson avenue, at $13,023.01; to Duffey & Hubbard, macadam, on East Chamberlain street, at $11,739.40; to Charles E. Hughes, planking between rails on River street, at $5,141; to Gund & Graham, brick paving on East River street, at $16,747.05.

DuBois, Pa.—About $9,000 will be expended on street improvements this summer. Material, brick. A. L. Bouton, city engineer.

Evansville, Ind.—To Western Construction Co., Trinidad Lake asphalt paving on eight streets, at $1.90 per square yard; to Pritchard Bros. Co., reinforced concrete pavement on Morris avenue and Jackson avenue, at $1.50 per square yard; to Bedford Nugent Co., Albion shale brick pavement on Water street, at $1.54 per square yard.

Franklin, Pa.—To Northwestern Construction Co., 13,000 square yards brick pavement on Grant and Atlantic streets, at $27,790.

Marietta, Ohio—To McGarey & Stowe, Akron, Ohio, 4.27 miles Washington county concrete road, at $55,580.

Newcomerstown, Ohio—To Wm. Brode & Co., city, two stretches of road paving in Tuscarawas county, at $54,784.

Norway, Mich.—To B. W. Hicks, Vulcan, Mich., bituminous macadam paving on Nelson street, at $7,300.

Orlando, Fla.—To Alabama Paving Co., Birmingham, street paving construction amounting to $200,000; to Hamilton Johnson, Orlando, curbing construction, at 30 cents per square yard.

Petersburg, Ohio—To Kennedy Bros., Youngstown, macadamizing Springfield-Poland roads, at $30,406.

Redmond, Wash.—To L. R. Ellis, Seattle, two miles brick paving on Redmond-Snoqualmie road, at $41,435.

Rockford, Ill.—To A. E. Rutledge, city, macadamizing of North Second street, at $12,221.55.

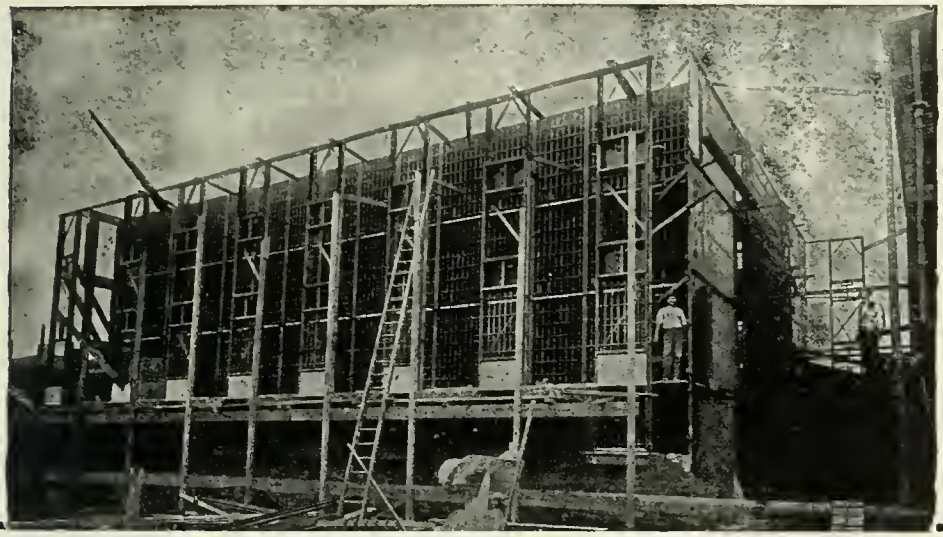
Salem, Ind.—To The Milroy Construction Co., Salem, paving of East Market street, at $11,000.

Sandwich, Ont., Can.—To Lennane Bros., Detroit, Mich., paving of Bedford street; contract price about $40,000.

Upper Sandusky, Ohio—To National Lime & Stone Co., Carey, Ohio, about 2 miles of pavement on Upper Sandusky-Findlay road, at $20,625; to Barnes and Almendinger, Rocky Ridge, about one mile of paving on Uncapher road, at $10,799.

V=A=N=D=O=R=N

Celebrated Steel Cells



View of Cage containing 120 cells at the Hartford County Jail, Hartford, Conn.
Erected by us before carrying up outside masonry walls.

For Prisons, Police Stations and Lockups

We are sole manufacturers ot the Van Dorn White Diamond Material, manufactured by a special process and offered by no other company. By this process our Burglar-proof work is made with an exterior coat of steel uniform in thickness and hardness, absolutely saw, file and drill proof, the core or center part being soft iron. Over 25,000 cells now in use have withstood prisoners of all grades, and the Van Dorn Jail is being known as the safest and most secure jail in existence.

Make Sure You Specify Van Dorn White Diamond Burglar-proof Material

THE VAN DORN IRON WORKS COMPANY

Prison Construction Department

CLEVELAND, OHIO.

CONTEMPLATED WORK.

Canton, Ohio—Contemplated improvement of Tuscarawas street, Market avenue, to Harrison avenue, by widening and repaving, estimated to cost as follows: Brick paving, $113,256, asphalt paving, $145,258, and wood block paving, $187,291. W. E. Sarver, city engineer.

Indianapolis, Ind.—Specifications adopted for paving East New York street, Arsenal avenue to Belt R. R. Estimated cost, $75,000. B. J. T. Jeup, city engineer.

Manatee, Fla.—$120,000 available for asphalt and brick paving. John Lloyd Minnis, engineer, Tarpon Springs, Fla.

Miami, Fla.—Contract will be awarded in August or September for 200,000 square yards of paving. Material not chosen. B. H. Clyce, city engineer.

SEWERS.

CONTRACTS AWARDED.

Aledo, Illinois—To Dalton Bros., Wilmette, Ill., sewage system, at $5,316.40.

Holley, N. Y.—To Frank S. Sposaeto, Syracuse, sewer system, at $39,074; to Foote & Graid, Rochester, sewage disposal works, at $9,700.

Indianapolis, Ind.—To Dunn-McCarthy Co., of Chicago, for Pogues Run sewer construction. Contract price, $907,061.31.

Perry, Iowa—To the Katz Construction Co., Omaha, Neb., west side sewer system, at $10,533.

Virginia, Minn.—To Lawrence McCann Construction Co., city, sewer system, at $66,-072.56.

White Sulphur Springs, Mont.—To C. H. Kelly, Kalispell, Mont., sanitary sewer system and sewage disposal plant, at $10,524.

CONTEMPLATED WORK.

Fredonia, Kans.—Construction of sewer below dam in Fall river, at cost of $25,000 proposed. Hal McFadden, city engineer.

Indianapolis, Ind.—Plans adopted by board of public works for construction of sewer in College avenue from 38th to 50th street. Estimated cost, $218,000. B. J. T. Jeup, city engineer.

Lyons, N. Y.—At special election held recently expenditure of $135,000 voted for installation of sewer system and sewage disposal plant.

Olathe, Kans.—Contract will be awarded in August or September for about 2,300 lineal feet vitrified pipe sewers of 8-inch; 2,400 lineal feet vitrified pipe of 10-inch; 4,700 lineal feet of trenching 6 to 14 feet deep. Estimated cost, $5,500. Roy Murry, city engineer.

Warroad, Minn.—Plans being prepared for proposed sewer system by Geo. W. Walker, engineer, Thief River Falls, Minn.

WATER WORKS.

BIDS REQUESTED.

Casper, Wyo.—Until about July 15, for water system costing $75,000. L. S. Worthington, city engineer.

Orillia, Ont., Can.—July 13, until 9 a. m., for water works extension. E. Long, chairman Orillia Light & Power Commission.

CONTRACTS AWARDED.

Cut Bank, Mont.—To C. H. Coffin, Chicago, Ill., water works system, at $29,000.

Hibbing, Minn.—Offer of Layne & Bowler Co., Texas, accepted by village council for furnishing water supply for village, at $398,-855.

Umatilla, Ore.—To W. G. Mulligan, Spokane, Wash., installation of water system, at $20,044.

CONTEMPLATED WORK.

Antigo, Wis.—Bond issue of $100,000 voted for purchase of city water works. Alex. Deleglise, city engineer.

Bay Minette, Ala.—Plans being prepared for proposed water works system at cost of $25,000 by Edgar B. Kay, consulting engineer, Montgomery, Ala.

Chinook, Mont.—The Jaqueth Co., Kalispell is preparing plans and estimates for filtration plant.

Milford, Ellis County, Texas—Bond issue of $14,000 carried for installation of water works system.

Milwaukee, Wis.—Improvements to water system consisting of short tunnel costing $275,000, a tunnel from intake tunnel to new station, at $350,000; pumping station with equipment, at $220,000, and several minor improvements are contemplated. H. P. Bohmann, water works superintendent.

Woodruff, S. C.—Bond issue of $60,000 for installation of water system will be voted on July 7.

MUNICIPAL ENGINEERING

The World's Leading Municipal Publication.

VOL. XLVII. AUGUST, 1914. NO. 2.

FLORAL DECORATION OF CIVIC BUILDINGS AS A CONTRIBUTION TO CIVIC BEAUTY.

The real price of everything, what everything really costs to the man who wants to acquire it, is the toil and trouble of acquiring it. What everything is really worth to the man who has acquired it and who wants to dispose of it or exchange it for something else, is the toil and trouble which it can save to himself and which it can impose upon other people.—ADAM SMITH.

Published by

Engineering Publishing Co.
INDIANAPOLIS, IND.

New York Office:
1127 World Bldg.
GEO. H. CLINGAN,
Eastern Mgr.

Chicago Office:
1634 Marquette Bldg.
E. D. POWELL,
Western Mgr.

Entered at Postoffice, Indianapolis, as Second-Class Matter.

A. P. Fox, President. **C. C. Brown, Editor.** **C. S. Sale, Gen'l Mgr.**

Subscription Price in U. S. and Possessions, Cuba and Mexico, $2.00. Canada, $2.40. Foreign, $2.75.

Changes of address, subscriptions, remittances and editorial matter should be addressed to MUNICIPAL ENGINEERING, Indianapolis, Ind.

BITULITHIC *on* MACADAM

ON MARLBORO STREET, BOSTON, MASS.

The economical resurfacing of old macadam streets on which traffic has increased until a better wearing surface is demanded is a problem which troubles many cities. The successful solution of the problem on several streets in Boston, Mass., warrants a description of the method used. The specifications are given almost in full because they show how to meet one of the difficulties, that of keeping the cost as low as it should be, by the simple expedient of paying for all labor directly. The method of separating the other items and leaving them open to competition in the bidding is ingenious and should result in the lowest possible cost of the completed work. The photographs show the various steps in the work and need no further explanation.

IN the year 1903, bitulithic surface on a crushed stone macadam foundation, was laid on Dartmouth street from Newbury street to Beacon street, in the fashionable residential Back Bay district of Boston.

The Dartmouth street pavement, now eleven years old, has proved so satisfactory that the taxpayers of Marlboro street, which intersects Dartmouth, have, for several years, urgently petitioned for the laying of bitulithic on Marlboro street, from Clarendon street to Massachusetts avenue. In the meantime the city has been attempting to keep the macadam on Marlboro street in repair by the frequent addition of new stone and surface applications of various forms of bituminous material, all of which have proved to provide periodically a dusty, muddy, oily and generally quite unsatisfactory wearing surface. During the spring of the present year Mayor Curley directed that the petition of the property owners, requesting a new pavement, be complied with, and Commissioner Rourke awarded the contract May 25 to Jas. Doherty for surfacing the macadam with bitulithic at a cost of $1.645 per square yard, including 5-year guaranty.

The bitulithic surface mixture is being made by Warren Brothers Company, at its permanent plant in East Cambridge, about two miles from the site of the work on Marlboro street. The contract price of bitulithic surface is $1.48 plus 16½ cents per square yard for scarifying and regulating the grade of the old macadam. This price does not include the hauling away of granite crosswalks, granite paving block gutters and other surplus materials, nor the furnishing of new stone to take the place of the gutter paving and crosswalks. It is estimated that the old granite gutter blocks and crosswalks, removed by the city, are worth about 15 cents per square yard of entire area of the street, so that the net cost of the improvement complete is about $1.50 per square yard.

Owing to the fact that crushed stone has been periodically rolled into the surface for about twenty years, the crown has become undesirably high, necessitating regulation of the surface and reshaping the crown by picking off the surplus macadam at the crown and placing it in the gutter and depressions in the surface of the old macadam. After this regulation of grade the macadam is rerolled and the standard crown of ¼-inch per foot of width and uniform grade thus established. All labor in connection with the regulation and rolling of the grade, but as noted above no new material in foundation, is including in the gross cost of $1.645 per square yard.

If the crown of the old macadam had

DARTMOUTH STREET, *Boston, Mass., June* 15, 1914, *from Marlboro street, looking toward Beacon street. Bitulithic surface, laid on old macadam foundation in* 1903.

not been raised by many years' accumulation of repairs the picking of the surface would have been unnecessary, except as to the few high spots which are always found to a greater or less extent on old macadam surface. It is most economical and desirable to build on the old macadam without disturbing it. During the years 1912 and 1913 Warrenite road was laid in Connecticut, under contract with the state highway department, to the extent of 55.9 miles of roadway, 16 feet wide, most of which was laid over the old macadam without disturbing it.

Warren Brothers Company's latest specifications include the following provisions applicable particularly to this class of construction:

"It is the general intention of this specification that the different parts of the existing macadam roadbed shall be given such treatment as will most economically give the desired results and any or all of the methods of treatment given below, or a combination of them, may be adopted at the discretion of the engineer for different portions of the work.

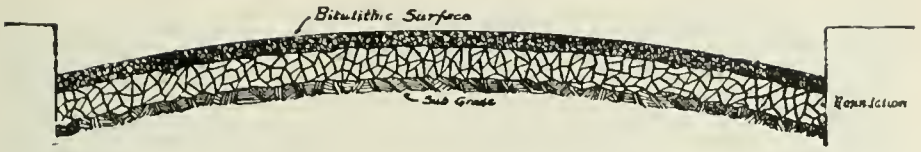
"1. Where the existing surface of the macadam is generally of suitable grade and contour, the surface of the existing macadam shall be swept for the width to be surfaced so as to dislodge and remove the detritus and expose the stone. The ruts and depressions existing shall be filled with bituminous binder which shall be compacted by tamping and rolling, so that the finished sub-grade shall be parallel to and substantially 2 inches below the proposed finished surface of the road. Bituminous binder shall be made as herein specified and shall be paid for at the price bid per ton of 2,000 pounds delivered on the site of the work. The cost of spreading, tamping and rolling the binder shall be paid for at the actual cost of labor plus 15 per cent. At the edges of the bitulithic surface, 2 by 4-inch joists shall be laid and spiked in position on the roadbed to provide a shoulder against which the bitulithic surface shall be laid, and after the surface is laid and rolled, the spikes and joists shall be removed and stone or gravel shall be spread over the shoulders to such depth and in such man-

ner as may be directed by the engineer. Stone and gravel shall be paid for at the price per cubic yard bid for these materials. The cost of labor in spreading stone and gravel, and of all spikes and joists, and the labor expended in placing same shall be paid for at cost plus 15 per cent.

"2. Where the contour of the existing macadam is such as to provide too flat a crown for the finished surface, the portions of macadam at the edges of the area to be resurfaced may be removed by picks or otherwise so as to provide a suitable contour and in cases where the new surface does not extend to a curb stone or header a shoulder shall be left in the macadam at each edge of the travel path against which to lay the bitulithic wearing surface. All labor required in removing such macadam shall be paid for at cost plus 15 per cent. Where the condition of the existing macadam surface is such as to require a general redistribution of the material in the roadbed, the roadbed shall be scarified and the material redistributed over the roadbed and thoroly rolled to the desired grade and contour. Where required by the engineer, loose stone or gravel shall be provided by the contractor. Such stone or gravel shall be paid for at the price per cubic yard bid for same and the labor required for the spreading of the stone or gravel and scarifying of the roadbed shall paid for at cost plus 15 per cent.

"3. Any soft springy places unsuitable for resurfacing shall be dug out and refilled with such material as the engineer may direct, thoroly solidified by rolling or tamping and brought to proper grade. Crushed stone, gravel, bituminous binder or Portland cement concrete which may

CROSS-SECTION *of bitulithic pavement on Dartmouth street, Boston, Mass., laid in* 1903. *Sample taken from cut for sewer in* 1911, *after eight years of use.*



CROSS-SECTION *of corrected old macadam foundation and new bitulithic wearing surface, showing the condition to be approximated by the new construction.*

be ordered used by the engineer will be paid for at the price bid for such materials and the labor required for preparing the sub-grade and the placing of all materials in place, shall be paid for at cost plus 15 per cent.

"Bituminous binder shall consist of sound gravel or crushed stone which will pass through a screen having openings 1 inch in diameter and will pass over a screen having openings ¼-inch in diameter, and, shall contain about 10 per cent. of sand screenings passing screen openings ¼-inch in diameter. The gravel or crushed stone shall be heated to a temperature of about 225 deg. F. and mixed with sufficient bituminous cement to thoroughly coat all the particles, after which it shall be hauled to the road and spread while hot over the roadbed as may be directed by the engineer. Bituminous binder delivered on the site of the work shall be paid for at the price per ton stipulated in the bid. The placing of the bituminous binder on the roadbed and the tamping and rolling of the same shall be paid for at actual cost of the labor plus 15 per cent.

"Crushed stone for the preparation of the roadbed and shoulders, where ordered by the engineer, shall be of hard sound stone of such size or sizes as may be required by the engineer. Crushed stone shall be paid for and delivered on the site of the work at the price per cubic yard stipulated in the bid. The labor used for the placing of the crushed stone in position as directed by the engineer shall be paid for at cost plus 15 per cent.

"Gravel shall be used as directed by the engineer in the preparation of the subgrade and shoulders. The gravel shall contain not more than 25 per cent. of material finer than ¼-inch and shall all pass a screen having 2-inch square openings and shall be acceptable to the engineer. Gravel, where ordered, shall be paid for delivered on the site of the work at the price bid per cubic yard. The labor used in placing the gravel as directed shall be paid for at cost plus 15 per cent.

"Where ordered by the engineer, portland cement concrete shall be laid to such depth as he may direct, and paid for delivered in place on the work at the price bid per cubic yard.

"On the foundation prepared as hereinabove specified shall be laid the following wearing surface composed of hard crushed stone, sand, and bituminous cement to have the thickness when compressed of 2 inches.

"The following method and apparatus shall be used in the preparation of the wearing surface. The stone and sand shall be heated in a rotary drier and while still hot, separated into the desired number of different sizes by means of a rotary screen having a minimum screen opening of 1-10 of an inch and a maximum opening of about 1½-inch. The openings in the successive screen sections up to ½-inch size shall not vary more than ¼-inch and not more than ¾-inch for the sizes larger than ½-inch. The aggregate thus separated shall pass into a bin having sections or compartments corresponding to the screen sections. From these compartments the aggregate shall pass into a weigh box, resting on a multi-beam scale. The desired amount of aggregate from each of the above compartments shall be accurately weighed separately on the scale and the batch dropped into a "twin pug" mixer where it shall be intimately associated and thoroly commingled with a predetermined quantity of bitulithic cement sufficient to coat all particles of the aggregate and to fill the voids in same. The different grades of stone

MARLBORO STREET, *Boston, Mass. Picking surface of old macadam to reduce crown preparatory to laying new bitulithic surface.*

and sand ranging in size from impalpable powder to about one-half the thickness of the wearing surface shall be combined in such proportions as to secure, in the mineral aggregate, inherent stability, that it, density or low percentage of voids, and stability or resistance to displacement, producing an aggregate which, when combined with the bitulithic cement and laid in place and compacted, will form a street paving structure consisting of mineral ag-

MARLBORO STREET, *Boston, Mass. Rolling the regulated old macadam roadway preparatory to laying bitulithic wearing surface.*

MARLBORO STREET, *Boston, Mass. Laying bitulithic surface over old macadam, after regulating the grade.*

gregate of different sizes and the bitulithic cement which permeates the entire mass fills the voids and unites the various particles thereof. If the crushed stone and sand do not contain enough finely divided particles or impalpable powder to produce a low percentage of voids in the aggregate the deficiency shall be made up by the addition of any other suitable fine mineral matter.

"The mixture and ingredients thereof shall be maintained at a temperature consistent with good workmanship. The mixture when reaching the street shall be hot enough to allow of being spread and raked and shall not be so hot as to injure the bitulithic cement.

There shall be spread over the bitulithic surface mixture a seal coat, using per square yard of bitulithic pavement approximately ¼-gallon of bitulithic cement, into which shall be incorporated approximately 25 pounds of mineral aggregate not larger than ¼-inch diameter. After spreading the seal coat, it shall be thoroly rolled into the bitulithic surface mixture.

"Each layer of the work shall be kept as free as possible from dirt, so that it will unite with the succeeding layer.

"The bituminous composition or cement shall in each case be free from water, and shall be especially refined to remove volatile and other matter susceptible to atmospheric influences.

"Warren Brothers Company, owner of the patents used in the construction of the bitulithic pavement, shall file with the proper official or board which is about to receive bids for the work, a properly executed binding agreement to furnish to any contractor desiring to bid for the work all the necessary bitulithic surface material, mixed ready for use, and bitulithic cement, and the sand, gravel, or stone screenings for the surface finish course, in accordance with sections, 'Wearing Surface' and 'Surface Finish', at a definite reasonable price per square yard. Said price shall include a license to use all of the patents required in the construction of the bitulithic pavement as herein specified.

"Bitulithic wearing surface and surface finish laid in place shall be paid for at the price bid per square yard."

The specifications are copyrighted, but cna be used by city and other engineers and municipal officials, provided they are not modified, as to wearing surface and surface finish, without permission.

MARLBORO STREET, *Boston, Mass. Spreading flush coat of bitumen and stone chips over bitulithic surface.*

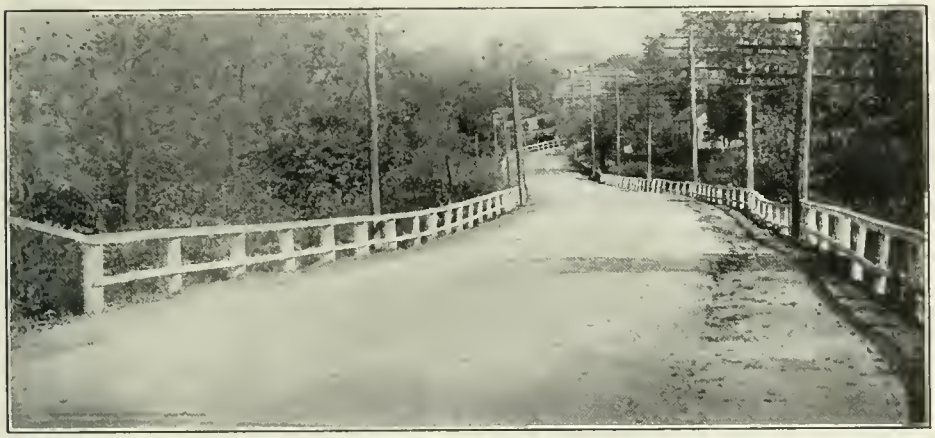
Necessarily, the cost of regulation of grade of the old macadam varies very widely, depending on the grade and condition of the old macadam and might vary as much as from 5 cents to 25 cents per square yard, depending on the quantity of new material required. On account of the varying conditions of the old macadam and consequently varying treatment, fairness to both contractors and city necessitates the establishment of unit prices for material and "force account" for the labor required in connection with the regulation of the grade of the old macadam. In fact, it is practically impossible for the engineer definitely to determine in advance of the letting of a contract, or until the work is in actual progress, exactly how much of each class

MARLBORO STREET, *Boston, Mass. Finished bitulithic surface laid over old macadam, from Dartmouth street, looking toward Clarendon street, on June* 15, 1914, *just completed.*

of new material will be required or how to treat most economically each part of the surface. If, therefore, the specifications provide that this preparatory work is to be done at a price bid per square yard the contractor must bid high enough to be safe and probably 50 to 100 per cent. more than the work would cost under fair unit prices for each class of material used and "force account" for the labor employed in preparation of the foundation. On the 55.9 miles of work in Connecticut on this basis the cost of preparation of the old macadam for the new surface averaged 11½ cents per square yard.

The accompanying photographs give a clear idea of the Marlboro street, Boston, construction above described.

BOSTON POST ROAD, *Greenwich, Conn., looking east, showing Warrenite surface laid on old macadam foundation.*



JERSEY CITY PORT DEVELOPMENT

Bion J. Arnold has been retained as consulting engineer and F. V. Lane as resident engineer, by the Jersey City, N. J., Chamber of Commerce, to make a study of methods of improving the transfer and transportation facilities of that port.

Primarily this work will be the development of the port facilities, which means that Mr. Arnold will be obliged to study the improvement of waterways, location and construction of docks and dock equipment for handling cargoes. A connecting railroad is an integral part of port development, so that all the railroads which terminate in Hudson County could be advantageously connected with each other and with all the docks which may be built on the waterfront and extending spurs to every part of the thousands of acres of low lands which are so exceptionally suitable for factory sites. Terminal yards and buildings and classification yards must be studied. Street locations and trolley lines enter into the problem of port development and must be given attention in any careful plan.

This development must be worked out with the city commissioner, county freeholders, the authorities of neighboring municipalities, with the New Jersey Harbor Commission and the New York Harbor Line Board of the U. S. Army, all of which must directly participate in financing improvements, or in constructing them, or in approving plans. Besides the governmental agencies involved, there are the railroads and steamship lines, the shippers and private owners of property, all of whose interests must be given due regard.

CITY GOVERNMENT IN NEW ZEALAND

By W. D. Hornaday, Austin, Texas.

The author is an experienced observer who has just returned from a trip thru New Zealand and gives an unprejudiced view of the marvelous progress made in this wonderland of the South Seas in the eighty years since the first white man was able to retain a foothold on its soil. He makes some statements which whet the interest in the results of some of the advanced experiments in municipal government which are in progress.

ONE of the most striking features of town government in New Zealand is the apparent cumbersomeness of the system, particularly as applied to the larger population centers. On the whole, however, the public affairs of the different municipalities have the appearance of being splendidly administered. There are ample evidences of the exercise of well directed civic pride. Just as the Dominion government of New Zealand has gone in extensively for nationalization of different public service systems and industries, so have the cities and towns adopted the policy of municipal ownership of practically all public utility plants and have assumed control of many other things that are supposed to contribute to the comfort and enjoyment of their inhabitants.

One of the remarkable features of New Zealand municipalities is the great number of boros that go to make up the four large population centers—Auckland, Wellington, Christchurch and Dunedin. Take Auckland as an illustration. The city itself has a population of only about 45,000 people, but closely adjoining it are the towns or boros of Birkhead, Davenport, Grey, Lynn, Mount Albert, Mount Eden, Newmarket, Northcote and Parnell, which, combined, bring up the population of what is commonly known as Auckland to about 110,000. The different boros fit closely and snugly together, making so far as appearances go, one solid city. Each of these different boros has its own municipal government, and usually owns its own public utility plants. It is a cumbersome and expensive municipal system that was brought over from England.

While the cities and their adjacent boros ordinarily work together harmoniously in public improvements and other matters that require more or less co-operation, it is apparent that much more could be accomplished for the good of the citizens of the respective municipalities if there were no intervening boundary lines. On the other hand, the supporters of the boro system of population centers claim that the rivalry of the different suburban towns has a stimulating effect on their growth and business development. This argument may be correct, but one of the things that New Zealand is suffering from at this time is an over-concentration of her population in cities and towns. It would be for the good of the Dominion if the municipalities were of slower growth.

Each city and boro fixes its own tax rate and this varies considerably in the different corporations. Some of the municipal entities have adopted the system of levying taxes on unimproved values, but this principle has not been adopted as generally as I had been led to believe before making an investigation on this account. It is optional with each municipality as to whether this single tax provision shall be placed in effect. In 1896 an act was passed by Parliament authorizing local bodies to adopt the unim-

TOWN HALL *at Wellington, New Zealand, a city of about sixty-six thousand population.*

proved valuation principle as to land. It provides in this law that a return to the old system of taxation can be made, if desired, after three years' trial of the new one. The method of determining whether the taxes shall be levied on unimproved value of land is by submitting the proposition to a referendum vote upon a petition of 25 per cent. of the tax payers where the total number in a boro or district does not exceed one hundred, and of 15 per cent. where the number exceeds three hundred. The proposition is decided by a majority of the votes cast. It is also provided that a rescinding proposal can be adopted by the same means as the one for putting it into effect, but not until after three years have elapsed. Once a proposal is rejected, it cannot again by submitted to the taxpayers until another three years are past.

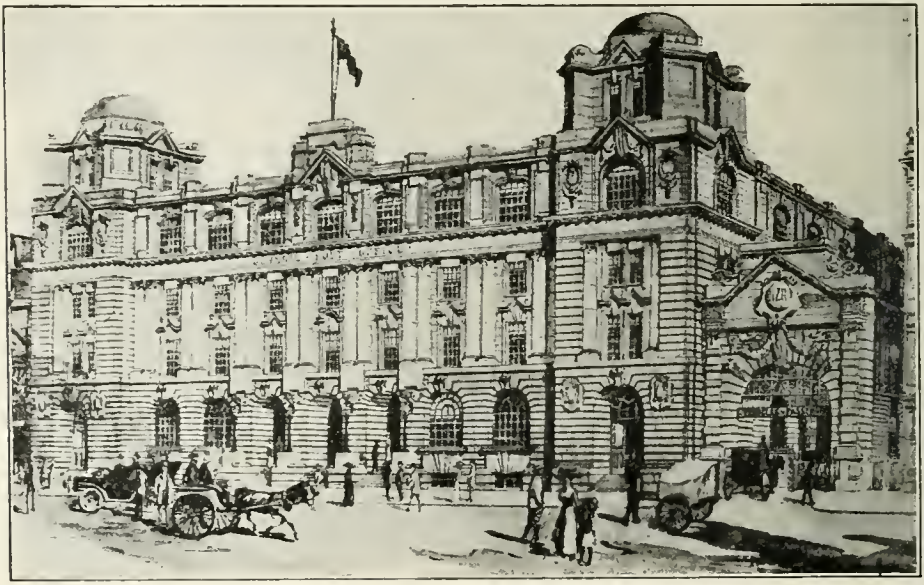
The system of taxing the unimproved value of land is in effect in Wellington and Christchurch, but the proposition was rejected by the taxpayers of Auckland and a number of other smaller municipalities. In Wellington and several of the boros, where the vacant lots are taxed on the unimproved value, the system has not given entire satisfaction. The chief complaint against it is that it has caused a too close settlement and has done away with many breathing spots around the homes in Wellington, particularly in the sections of the city where land values are high. Many of the home owners can hardly afford to retain an unoccupied lot. This has caused dwellings to be jammed close together and has done away with flower gardens and other surroundings that add to the beauty of a home. The difference in this respect between Wellington and Auckland is apparent even to the most casual visitor. In the latter city there are well-kept lawns and flower-embowered spaces adjoining many of the residences. It is not apparent, either, that the system of taxing the unimproved value has stimulated the building up of the business districts of the towns where it is in effect.

The general municipal tax rate authorized by law is 50 cents in $5 on the annual or 3 cents in $5 on the capital value of all taxable property or its equivalent on unimproved value.

Where boros are divided into wards, the rate levied may vary in the different wards, but must in any case not exceed the legal limit. The system of taxation is

AUCKLAND, *New Zealand, is a city of about one hundred thousand population. The upper photograph shows the Town Hall and the lower shows the general postoffice.*

upon the basis that 25 cents in $5 on the annual value of the property, by which is meant its worth as assessed annually, is deemed to be equivalent to 1½ cents in $5 on capital value of any taxable property. The assessment of the unimproved value must be so adjusted as to equal as nearly as possible in producing capacity the limit of taxing power on the capital or annual value as the case may be. The annual



value is deemed to be the letting value less 20 per cent. in case of dwellings, buildings and other perishable property, and 10 per cent. of land, but in no case less than 5 per cent. of the value of the fee simple. The capital value is deemed to be the selling value of the land, including improvements at the time of the valuation, excluding the value of any existing improvements.

The functions of municipal councils in New Zealand are much the same as those of similar bodies in the United States. It would seem that not as much progress has been made in municipal government affairs here as has been accomplished in those relating to the Dominion itself. While different city and boro administrations are honest and well meaning, their officials are not given the latitude for accomplishing things for their people that one might expect to find.

The dividing of the larger population centers, such as Wellington, Auckland, Christchurch and Dunedin, into a number of suburbs or boros, each with its separate government organizations, makes conditions more or less complicated. Each town council shall consist of not less than six or more than twenty-one members, according to the population, who are elected every two years. The mayor, who presides over the council meetings, is elected annually. The councils have under their control the construction, maintenance and operation of all public improvements and public utilities.

Much attention is given to providing park and recreation grounds and giving the people an abundant supply of pure water. The streets of all the cities are well kept, many of them being paved and otherwise improved in a modern manner.

As an example of what a New Zealand municipality is doing, particularly in the way of operating its public service properties, Wellington may be cited. The assessed capital value of its property on March 31, 1913, was $95,807,125; unimproved value, $50,456,000; value of improvements, $45,351,125. These figures apply only to the city itself and do not include the adjacent suburbs, the population of the city being 66,138 and covering an area of 9,505 acres. Within this area were 17,372 buildings. The revenue for the fiscal years, 1912-13, from all sources, was $2,216,715. This sum was derived from taxes amounting to $768,360 and the balance being made up from payments made from rents, baths, town hall letting, licenses, organ recitals, orchestral concerts, abattoirs, water, libraries, cemetery,

RESIDENCE STREET *in Auckland, New Zealand. Note the ample space about the houses. Single tax is not in operation here.*

GRAFTON BRIDGE, *of reinforced concrete, at Auckland, New Zealand.*

crematorium, zoos, building fees, interest on deposits, fish market and other sources. The total amount of money expended by the city in the same year was $2,142,255. The total indebtedness of the city was $11,445,250. This is made up of a large number of loans, which bear interest at the rate of 4 to 4½ per cent. The total sinking fund on March 31, 1913, aggregated $1,307,814.

The Wellington corporation owns the electric street railway system, which was constructed at a cost, including the power plant, of $8,240,605. It also owns the electric lighting system and water works plant and distributing system. The electric tramways department of the city is headed by an electrical engineer, the other officials being a traffic superintendent, accountant, superintendent for public ways, power stations superintendent, light superintendent, overhead equipment superintendent, power sheds superintendent and two traffic inspectors. The board of management consists of the city engineer, who is chairman, the electrical engineer and the traffic superintendent. The lines have been laid in the main streets of Wellington and all the suburbs, extending to many of the pleasure resorts on the different bays and other places of interest. The total number of cars in operation is 87, consisting of eight different types, the capacity of each ranging from twenty-four to one hundred and three passengers. The power station was constructed at a cost of $551,000. The system consists of about seven miles of double track and thirty miles of single track. During the fiscal year 1912-13, 23,858,412 passengers were carried, which was an average of 11.8 passengers per car mile. The average fare per passenger was 2 4/5 cents. The total population served was 68,000. The average journey per head of population served during the year was 350 miles. The average traffic revenue per head of population served during the year was $11.07. The net surplus from the tramways for the year was $59,525, and from the power supply and public lighting $5,490.

The city owns its own abattoir, which has accommodations for slaughtering all live stock required for local consumption other than that which had already been provided for by the various local meat dealers. These companies are subject to government supervision.

The pretty custom of naming the residences instead of numbering them is in vogue in several cities and towns. In Auckland the adoption of Maori names for homes is quite general. Usually the name is painted on the fence in front of the property or is given a prominent place upon the door of the house itself.

The masses of New Zealand are lovers of outdoor pleasures, and in order to provide places for recreation the different municipalities maintain beautiful parks and playgrounds. As a further contribution to the enjoyment of the citizens, the city of Wellington has an official organist who gives public recitals in the auditorium of the town hall. Not long ago there was some objection raised by local citizens as to the character of music which the organist was giving the public. Some wanted classical while others thought ragtime or other popular airs would be more generally appreciated.

The fact that many of the larger cities and towns are situated near the ocean makes bathing and aquatic sports the chief advertisement for a large percentage of the population. On holidays and Sundays, crowds of people flock to the different resorts on the sea-shore.

PRINCESS STREET, *the business street of Dunedin, New Zealand.*

AUTOMOBILE STREET CLEANING MACHINES

One of the latest applications of the motor vehicle is to street cleaning and sprinkling. There are many forms of machines which have been developed, a few of which, gathered from various cities, are here described so that they can be compared and contrasted for the kinds of work to which they are adapted. The American machines compare most favorably with those from foreign cities.

STREET cleaning, including sprinkling, sweeping and flushing, is a field which is being rapidly taken by the motor, even under the conditions of the problem which prevent the full utilization of the greater speed of which the automobile is capable. Nevertheless, the quantity and quality of the work and the relative cost cause municipal officials to look favorably upon motor apparatus for these purposes.

The municipal officer considering the question requires information on two points. He can easily be assured of the superiority of the motor on the score of hygiene, but, naturally, the matter of cost is important. Figures which are most informative on this point are those, not of office estimates, but which have been recorded in actual service. Those based on the results obtained in different cities, in which the machines illustrated are used, may be of special interest.

A decade ago, the City of Paris placed in service one of the French motor sprinkling machines shown in one of the accompanying photographs, and this machine is still running and is greatly admired by the users for the ease with which it sprinkles the wide roads of the Bois de Boulogne.

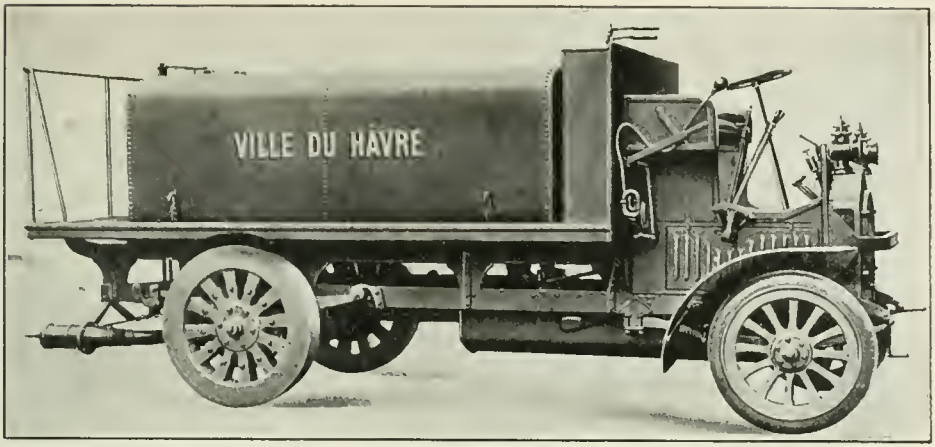
The cities of Versailles, Havre, Dijon, Deauville, Trouville, Monte Carlo, Santander, Buenos Aires and Mendoza, soon followed the example of Paris.

In sprinkling streets in Versailles, France, a tank of 660 gallons waters a surface of 13,156 square yards, say 20 square yards per gallon, and twenty-five charges are used in a ten-hour day, covering 328,900 square yards. An ordinary horse-drawn tank waters about 42,000 square yards in a ten-hour day and one motor waterer can replace six, seven or even eight horse-drawn sprinklers.

Now comparing the costs, per ten-hour day, the driver, fuel, depreciation and lubricants for the motor cost about $8, while the daily expense of a horse-drawn sprinkler is about $3, at least six being necessary to do the work of one motor sprinkler.

The efficiency of the motor device is increased because the water is distributed under adjustable pressure and the forcible washing of gutters is possible. This system is particularly practicable for streets having a double tramway track, as the water can be sprayed sideways and the obstruction caused by the motor sprinkler is reduced to a minimum. The work is done much more quickly than by horse machines, and therefore by a much smaller number of interruptions to the traffic.

The motor driven watering wagon illustrated, is mounted on a 25-h. p. chassis. The tank holds 770 gallons, the water being delivered to two Plainclamps distributors, as used by the City of Paris, by a pump driven from the engine. The control of the distributers is effected from the driving seat, both the force of the spray and the width of service washed being variable to a nicety. The best pace for watering is found to be 7½ miles per hour, and a stretch of roadway up to 65



FRENCH MOTOR SPRINKLING MACHINE *in use in Havre, operated by a 25-horse-power motor.*

feet in width can be treated at one operation. One of these wagons does the work of eight horse-drawn watering wagons.

The motor sweeper works at an average speed of 6¼ miles per hour and on rough roads, or when dealing with thick mud, a speed of about 4½ m. p. h. is acquired. The length of the roller-brush is two meters (6 ft. 7 in.), but it is arranged to sweep obliquely, and its effective track is about 6 feet wide. Not accepting the most favorable figures, the motor brush sweeps a minimum of 17,000 square yards per hour, altho the track swept (6 feet) multiplied by the distance covered in one hour, 6½ miles, equalled 22,880 square yards. Horse-drawn brushes sweep an average of 4,300 square yards, therefore the amount of work done by the motor machine is over five times that done by the horse. The daily cost of a motor sweeper is about $8, including the expense of fuel, labor, depreciation and lubrication, while the daily cost of horse drawn sweeper is about $4. To ascertain how many motor sweepers are necessary the streets are tabulated and classified, separating those to be swept daily, on alternate days and weekly, and then arranged in a program to keep the motors busy.

A percentage must be deducted, as shown above, for overlapping, and 10 per cent. deducted which must be hand swept, in gutters, around obstructions, etc.

Regarding the construction of French De Dion Bouton street cleansing apparatus, it may be stated that the sweeping machines are built on a 14-h. p. chassis, with the engine under a bonnet in front of the dashboard. The sweeping is done by a cylindrical brush carried obliquely from side to side of the frame, the brush being rotated by gear-drive from the differential in the opposite direction to that of the road wheels. All the driving gear is completely enclosed, so that neither dust nor mud can reach it. The driver controls the brush from his seat, a single lever controlling both the brush itself and its driving gear. To lay the dust while the sweeping is in progress, and secure a more effective sweeping than would otherwise be obtained, the machine is provided with a tank holding 250 gallons of water, which is sprinkled just in front of the brush. The sprinkler is worked by a small pinion pump driven off the engine and controlled from the driving seat. The best pace for sweeping is said to be 5½ miles per hour.

The French combined sweeping machines and watering wagons are of unique construction. The motor-driven sprinkler and sweeper is provided with a 570-gallon tank, placed on an 18-h. p. chassis, with engine beneath a bonnet in front of the dash. The machine combines a brush and water-spray of the type used on the 14-h. p. sweeping machines and is provided with a water-distributer like that on the 25-h. p.

watering wagons. There are thirty machines of this type in use in the city of Paris. This is a very convenient machine, especially attractive in cases where a city wishes to try mechanical street cleansing without too heavy an experimental expenditure. By combining as they do, the usefulness of two types on a chassis of medium power, they are very economical and not excessive in cost.

The second illustration shows a Kisselkar street flusher in use in St. Paul, Minn. This car can deliver the water thru the flat flushing nozzles, as shown, at a pressure of about 48 pounds per square inch if desired. The load on the machine is over 3¾ tons and the power is sufficient to carry the machine up steep hills on the first gear. The machine shown in the photograph is climbing the Sixth street hill, one of the steepest streets in the city, and is flushing it on the way.

An English motor sprinkler with Mather & Plant centriflugal pump, as developed at Luton, England, with an 1,100-gallon water tank and a motor of 70-h. p. for Canadian service, is shown in the third photograph. This motor sprinkler consists of a 7-ton chassis, fitted with sprinkling and flushing gear and is in use by the street cleaning and scavenging department, of Edmonton, Alberta.

Besides Warwick sprinklers, this English motor wagon is fitted with flushing nozzles which can be arranged at any inclination for use in laying thick dust or for flushing out gutters. The centrifugal pump is placed behind the driver's seat and forces the water thru the flushing nozzles onto the road surface or into the gutters at a pressure of 60 lbs. per square inch.

A new automobile street sweeper, from Sandusky, Ohio, has been developed by Bernard Kern from three steam driven machines and a storage-battery machine built and used in succession, and each an improvement on its predecessor, to the present machine shown in the last of the accompanying illustrations. The four small photographs show the steps in its development. The perfected machine is described as follows:

The sweeper is operated by gas-electric power, having separate motors for the individual parts. The broom consists of fine bassine which enables it to dislodge the finest particles of dust from the pavement, throwing it into the air current which is created by a large suction fan,

KISSELKAR *motor street flushing machine on Sixth street hill, St. Paul, Minn.*

MOTOR STREET SPRINKLER AND FLUSHER *of English design in use in Edmonton, Alberta, Canada.*

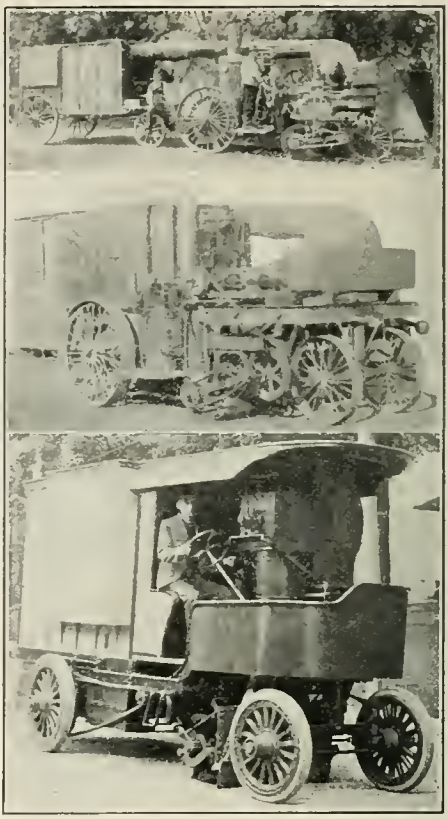
the air carrying the refuse thru conduit back into the dirt box. This trailing box is divided into two compartments, one compartment being used as an expansion chamber in which the heavier particles are deposited.

The light dust, which will follow a current of air, is carried into a dust collector, which is composed of a series of cloth pockets, revolving on a drum. These cloth pockets being shaken, automatically deposit the fine dust into a dead-air chamber. The air that passes thru the cloth of this dust collector is again filtered by a series of screens packed with a vegetable matter, thus discharging the air entirely free from dust. When the box has its load it is detached and taken to the dump by a team of horses, and an empty box is replaced, thus eliminating any scattering of dust on the street.

The machine is so adjusted as to adapt itself to all kinds of pavements, being as efficient on the uneven pavement as on the smooth asphalt pavement. The large sweeper is provided with a foot board to carry a helper. When the machine is working on very uneven pavements, the holes in the pavement that are beyond the deflection of the broom are swept out by this helper. Any heavy litter on the streets is picked up by the helper and deposited in a receptacle that is provided on the front end of the dirt box.

From recent experiments made by this company with their machine in Sandusky, Ohio, on an asphalt block pavement swept early in the spring aud having the accumulations of the entire winter, the amount of dirt swept up by the machine average eighteen yards to the mile of 30-foot pavement. Some interesting facts will be noted from this test. The expansion chamber in the dirt box contained four yards of heavy material, mostly sand, which averaged in weight 2,040 pounds to the cubic yard, the dead air chamber containing about one cubic yard of dust as fine as flour.

Another test of the machine was on a brick pavement in a business section, consisting of six blocks about one-half mile in length and 40 feet wide, two blocks being of the old kind of pavement having a sand filler for binder, very uneven, and full of holes; two blocks consisting of old style pavement with sand binder and



THREE STAGES *in the progress of the Kern automobile street sweeper, sprinkler and flusher. Upper, steam-driven machine with trailer dust box. Middle, steam-driven machine, self-contained. Lower, storage-battery machine, leading to the latest machine in the larger photograph below.*

being in a smooth condition; two blocks being of the modern type with a cement filler. The first time that the machine swept this territory, the average was three-quarter cubic yard to the block. The pavement was swept again after two days without any attention in the interim by the "white wing" system. The accumulation from this same territory was one and three-quarter yards from the six blocks. It was again swept after one day's accumulation and the amount picked up then was three-quarters of a yard over the entire territory.

In the first sweeping, the heavy material in the expansion chamber averaged about six times as much as that in the dead air chamber, which consisted of fine dust.

MOTOR STREET SWEEPER, *with dust collector and detachable bins, operated by electricity generated by gasoline-driven generator.*

The second time it was swept, the expansion chamber contained about eight times as much as the dead air chamber. The third time, the relative proportion was about ten to one between the expansion and the dead air chambers. After this territory was swept the third time, the pavement was entirely free from dust and by drawing one's hand over the pavement there were no indications of dust left on the hand.

The trailing dirt box can be detached and a watering tank attached, and, if necessary, the broom of the sweeper can be removed and a squeegee attached to scrub the streets. The squeegee developed for this machine is composed of a series of adjustable shovels, each having a flexible shoe, which will enable the shovels to adjust themselves to the irregularity of the pavement.

Good Roads as Crop Producers

That an improved road will increase vastly the productiveness of the area thru which it runs, has now been satisfactorily demonstrated by studies conducted by the United States Department of Agriculture in Virginia. Conditions in Spotsylvania county were investigated with particular care and the results have proved surprising. In 1909, the county voted $100,000 to improve forty miles of roads. Two years after the completion of this work the railroad took away in twelve months from Fredericksburg, the county seat, 71,000 tons of agricultural and forest products, hauled over the highways to that town. Before the improvement of the roads this total was only 49,000 tons annually; in other words, the quantity of the county's produce had risen more than 45 per cent. Still more interesting, however, is the increase shown in the quantity of the dairy products. In 1909 these amounted to 114,815 pounds, in 1911 to 273,028 pounds, an increase of practically 140 per cent. in two years. In the same time shipments of wheat had increased 59 per cent., tobacco 31 per cent. and lumber and other forest products 48 per cent.

In addition to this increase in quantity the cost of hauling each ton of produce was materially reduced. In other words, the farmers not only produce more but produce more cheaply, for the cost of transportation to market is, of course, an important factor in the cost of production. In the past two years the traffic studies of the Federal experts show that approximately an average of 65,000 tons of outgoing products were hauled over the improved roads in the county an average distance of 8 miles, or a total of 520,000 ton-miles. Before the roads were improved it was estimated that the average cost of hauling was 20 cents a ton-mile, after the improvement this fell to 12 cents a ton-mile, or a saving of 8 cents. A saving of 8 cents per mile on 520,000 ton-miles is $41,000 a year. The county's investment of $100,000 in other words returns a dividend of 40 per cent. annually.

Because this saving, in cases of this character, does not take the form of cash put directly into the farmers' pocket there is a widespread tendency to believe that it is fictitious profit, while as a matter of fact it is just as real a source of profit as the increase in the price of wheat.

In Dinwiddie County, Virginia, for example, where peanuts is one of the staple crops, the average load for two mules on a main road was about 1,000 pounds before the road was improved. After its improvement the average load was found to be 2,000 pounds and the time consumed in hauling the larger load to market was much reduced. In other words, one man with a wagon and two mules could do more than twice as much work with the improved road than with an unimproved road. This is the explanation of the extraordinary rise in the total output of agricultural products in a county with a good road system.

MUNICIPAL STREET RAILWAY

OF EDMONTON, ALBERTA, CANADA

The material in this article is taken in substance from the last annual report of the street railway department and shows clearly and without concealment what the condition of the department is and the reasons therefor. It is worthy of the most careful study because it shows, by the comparison of former conditions with the results of modern accounting systems, what cities almost always fail to include in their summaries of cost of operating their public utilities and the resulting deficiencies in operating results. The report recommends methods of preventing these deficiencies and shows where certain difficulties will disappear, and while these are local in their nature they give pointers which other cities will do well to follow.

THE city of Edmonton, the capital of Alberta, Canada, owns most of its public utilities, including its street railway system. The city has recently installed a complete system of accounting.

In October, 1912, a scheme for the provision of depreciation, covering the difference between full depreciation, based on the estimated lifetime of each class of work, and the provision made by the sinking fund was decided upon, to take effect as from the beginning of the new fiscal year, commencing November 1, 1912. This was given effect to, and was made retrospective to the beginning of 1908. All of the utilities and several of the departments, such as police, fire, stores and works, and street departments have made ample provision for depreciation and obsolescence. While this has had the effect of increasing a deficiency in some of the departments, it was necessary to put the matter on a sound basis, as otherwise the true losses of the several departments would not be ascertainable from their accounts.

With regard to the power plant, the basis of provision for depreciation was the ultimate reduction in the cost per k.w. to the equivalent of a modern and efficient plant. With the other utilities, each class of plant has been treated separately. It is the intention to use this reserve fund of the power plant to immediately provide a modern plant to replace the obsolete and inefficient plant, which has been discarded considerably in advance of the periods covered by the several loans from which such assets have been acquired. The ultimate effect of this policy, which it is expected will be completed, so far as immediate replacement is concerned, by 1915, will be that the power and pumping plant will represent the actual physical value for modern and efficient plants of the very highest type. When this is the case, the cost of power will be very materially reduced. It has been suggested that instead of using depreciation and obsolescence fund for replacement, further debenture issues should be made, having the effect of spreading the replacement over a longer period. We feel, however, that such a policy cannot commend itself as sound or wise. Unsound because it will carry assets on the books which are not true assets, and unwise because it will not permit of a reduction in rates that would otherwise accrue. It is true that the creation of this fund in the power plant has been at the expense of the departments which are the only customers of the plant,

but it has been coincident with a reduction in rates to those departments, and the problem of placing the water works and street railway departments on a paying basis is one that should be treated separately, and not at a sacrifice of a sound policy in regard to the treatment of defective assets of the power plant.

There has been a heavy loss in the operation of the street railways department for the fourteen months ending December 31, 1913, amounting to $129,636.99, and after providing the newly established reserve for depreciation, the loss has been considerably increased, and the total deficiency to date is $405,394.07. This utility has been extended considerably beyond the ordinary requirements of the city, the consequence being that insufficient revenue has been obtained. With the extended service that is given to each individual passenger, the tariff of fares is not high enough. It has been put forward that companies charging a 5-cent fare have, in addition to expenses, to provide profit for shareholders. It should, however, be borne in mind that the city pays approximately 5 per cent. interest, and about 3 per cent. for sinking fund, in addition to a heavy charge for depreciation. It might reasonably be held that 8 per cent. for interest and sinking fund is equivalent to the dividend that would be paid by privately owned undertakings. Proposals for an increase in fares, approximating to an all-round 5-cent fare, are under consideration.

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¶ RECONSTRUCTION *of old roadbed, building new barns and buying new equipment for increased business required large capital investments in 1913.*

The work of the department for the year might be emphasized as being a reconstruction of a large portion of the old roadbed and material new extensions, bringing the total mileage up to 50.3 miles, measured on a single-track basis. The more important parts of the system are now taken care of by permanent track laid on a 6-inch concrete slab, filled to the top of the ties with concrete, and finished with a street paving surface. This will reduce the cost of maintenance very materially, besides giving a better class of roadbed on which to operate.

The passenger traffic has increased materially during the year, and also the system has been supplemented by further additions of new cars.

The department moved into its new offices and new car barns and workshops in May, and is now in a position to handle properly and efficiently all car repairs and other items of maintenance required.

The heaviest traffic for any one day during the year was during the exhibition in August, when something over 70,000 passengers were carried.

The freight business of the department has also expanded. This makes possible certain valuable properties being served with trackage which could not otherwise be done direct from the steam railways.

The entire system was carefully gone over at the end of the year, and it was determined to make provision for certain depreciation charges not previously taken care of. This has added quite a burden to the system, but this must necessarily be considered in order to keep the system up to its proper value.

Very little construction work is contemplated for the ensuing year, as there is sufficient mileage to serve the needs of the present population.

It is maintained that, were the street railway to receive all its current without charge, it would still not make a profit on its present showing. This is doubtless true, but it is a simple proposition to state that any reduction will operate towards minimizing the annual loss. If, therefore, it can be shown that the charge for current is unduly high, every energy should be given towards securing that the basis of charge be equitable. From the paragraph on the power plant it will be seen that the street railway is helping to cover within a short period a very large amount of obsolescence in the power plant. If the present policy is carried out, the street railway can look for no relief under this head for nearly two years yet, after which there should be a substantial reduction in the cost of power.

In comparing the charge for street rail-

way current in Edmonton with other cities, care should be taken to ascertain the method of measurement. Up to November last the Edmonton street railway had to pay 2.4 cents per kw. hr., but of the total current approximately 80 per cent. was alternating current and only 20 per cent. direct current. The loss on conversion of the former is fully 20 per cent., raising the real price of the current to almost 2.8 cents. About the same time that the rate was reduced to 2 cents, the introduction of new machinery made the proportion of A. C. and D. C. about 50 per cent. each, or equal to 2.2 cents all round on a D. C. basis.

The benefit of the reduction only affects the last two months, and the rate is still high. If the power plant problem were solved by the transference of its obsolescence to general taxation, the street railway would stand to receive a substantial credit as its share of the power plant's "revenue surplus," and would be at once relieved of any further contribution to power plant obsolescence.

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¶ DEVELOPMENT *of system beyond present needs has caused deficit which is offset at least in part by favorable effect on city's growth.*

Probably the two most important factors which contribute to the lack of success that has hitherto marked the history of the street railway are:

The geography of the city itself, and the fact that the development of the street railways is substantially ahead of that of the city.

Edmonton has developed in easterly and westerly directions, owing to the presence on the north of the Hudson's Bay reserve and on the south of the Saskatchewan river. Both of these are responsible for long hauls with little chance of intermediate fares.

Unremunerative lines include the Bonnie Doon, Whyte Avenue West and the Low Level Bridge services, which the city is obliged to maintain under the Strathcona amalgamation agreement. Another unprofitable service is the Athabasca avenue line. In these instances, if in no others, there seems little doubt the street railway is built ahead of present requirements, and has thus to meet sinking fund and interest, and operation and maintenance charges, which are not nearly equaled by the revenue derived.

Notwithstanding statistics to the contrary, it would appear that the street railway has been extended into districts where there is not yet a sufficient population to justify the construction of the lines, if viewed from a purely commercial standpoint. For the present the railway has to maintain these services, and it is to be hoped the facilities of transit afforded thereby will so develop the districts in question that the services will, in the course of time, be remunerative. Meanwhile the street railway is burdened with the heavy deficit of $405,394.07, to carry which it has no funds of its own, and must, therefore, suffer heavy interest on this sum, in addition to its ordinary charges.

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¶ METHODS OF REDUCING *annual deficits are suggested, and the largest source of last year's deficit is shown to be due to equalization of depreciation accounts, now permanently taken care of.*

Seeing there is little prospect of material improvement in the near future, and as the street railway has suffered considerably by being required to furnish the citizens with transit facilities which cannot as yet be other than unprofitable, there seem good grounds for the council to consider means whereby this deficit may be cleared off and the street railway be given a fresh start. There are two practicable ways.

One is to wipe out the power plant obsolescence; refund the street railway its share of the overcharges already made; reduce the price of current to cost; and raise additional revenue by increasing fares to a straight 5 cents, with reduced fares only to workmen and children.

The other way is to raise sufficient money from general taxation to clear off the deficit, in either one or two years, and to raise fares until it can be demonstrated that the street railway can afford to reduce same and still pay its way.

Capital expenditures during the fourteen months were $1,421,145.32, mainly for new track, rolling stock, new car barn, overhead trolley wire, high level bridge and land.

The revenue and expenditure report for the fourteen months' operation shows a deficit of $191,934.62; of this amount, however, $63,289.12 is a special charge against revenue for dismantling the old car barns and for depreciation. The actual loss on the fourteen months' operation, excluding this amount, is $98,545.50; the receipts for the past year increased from $437,495.62 to $727,720.10; however, as already stated, this revenue is for fourteen months, against twelve months in the last annual report, and the actual increase in the receipts is 43 per cent. This increase is very small, compared with the percentage of increase experienced by the department during the two previous years; the increase in the receipts for 1912 and for 1911 was 78.4 per cent. In making provision for the 1913 operations the department estimated that the increase in receipts would be approximately the same as in previous years, and based all their calculations on this assumption. It is a well-known fact now that the year 1913 was a disappointing one in the west; the increase in population, which had been phenomenally rapid in the city, did not continue at nearly the same rate, and, in consequence, the receipts of the department suffered; at the same time the receipts also suffered to a great extent during the summer months, owing to the large amount of construction work which was under way. These two circumstances will explain the reason for the increase in receipts during 1913 not being as great as in previous years. Even with the increase recorded the department shows a very gratifying increase in revenue. An increase of 43 per cent. under the adverse conditions experienced speaks very well for the future prospects of the city in general and the department in particular.

The percentage of working expenses to gross receipts has this year shown a distinct improvement, this percentage being lower for 1913 than for any year since the system started, with the exception of 1909. The improvement is all the more noticeable because the past year was an extremely arduous one, as for several months the traffic had to be carried over tracks in course of reconstruction, which all meant an increase in the working expenses; also, during the time that the construction work was going forward changes had to be made from time to time in the routing of the cars. This not only meant actual loss in traffic, but meant additional transferring, longer hauls and a generally unsatisfactory service.

The following are some figures in connection with the department for 1912 and 1913:

	1912	1913
Total number of cars	50	80
Number of car miles	1,203,260.27	1,899,336.00
Number of passengers carried	10,307,422.00	14,973,781.00
Journeys per head of population per annum (on the basis of 53,000 population)	194	
Journeys per head of population per annum (on the basis of 67,000 population)		224
Average number of passengers per day	28,162	41,024
Average number of car miles per day	3,288	5,204
Number of passengers carried per car mile	9	7.89
Average fare per passenger	4.06	4.08
Earnings per car mile	36.2	33.2
Expenses per car mile	36.06	42.7
Number of passengers per car per annum	429,476	417,097
Revenue per car per annum	$18,226.96	$17,820.85
Date of heaviest traffic	Aug. 15,1912	Aug. 14,1913
Number of passengers carried on that date	65,400	70,344
Number of motormen and conductors	156	251
Passengers carried per mile, single track basis	340,000	285,000
Earnings per mile, single track basis	$14,500.00	$11,940.00

GARBAGE INCINERATORS AND DESTRUCTORS

By Sterling H. Bunnell, New York City.

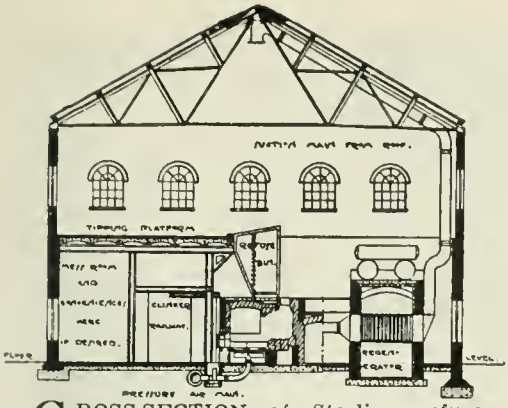
The author of this article is experienced in the solution of garbage disposal problems and here shows the fields of garbage reduction and of garbage and waste destruction. He then describes the processes in the modern English type of refuse destructor with references to various plants of this sort in operation on this continent, and illustrates his description by photographs of outside and inside of one of the latest plants put in operation, that at Berkeley, Cal.

THE disposal of the garbage and refuse of cities is becoming one of the great problems of municipal life. In the early stages of a city's growth the rubbish and refuse is usually dumped in hollow places or on low lands, and serves as filling material. As the city increases in size the amount of refuse increases in proportion and land becomes less accessible from the thickly settled parts of the town. A rubbish dump creates a nuisance, is a menace to health, and a fire risk as well; while the dumping of garbage along with refuse increases the nuisance tenfold. The garbage disposal problem generally comes up as one of the serious questions before the city authorities long before the city has grown to what may be called large size.

The waste of cities may be divided into three classes: Garbage, comprising putrescible refuse, table scraps, commission house offal and other waste from food substances, to which is occasionally added the carcass of a dead animal. Ashes from house fires and factory furnaces are produced in large quantities, and comprise the only form of city waste which can be safely used in filling low ground. Ashes can also be used to some extent in road surfacing in the suburbs. The third class of waste is dry rubbish, comprising waste wood, sweepings, lawn cuttings, branches from shubbery, paper, rags, old shoes and other cast-off articles.

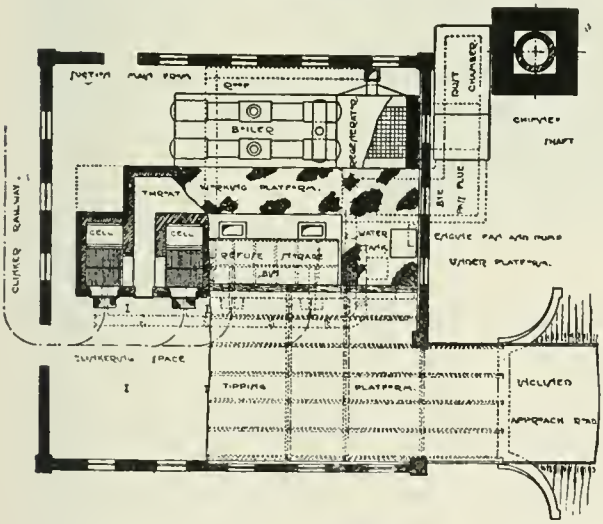
The three classes of waste, if obtained in sufficient quantities, can be advantageously treated separately. In cities of large size, where the class of garbage alone amounts to one hundred tons or upwards per day of twenty-four hours, the reduction system has many advantages. The garbage is collected in steel wagons, delivered to a reduction plant situated at a proper distance from the thickly settled portions of the city, and there converted by cooking and pressing processes into grease and tankage. In these operations a large quantity of stick-water is produced, which, if allowed to run to waste, creates a nuisance and is extremely unsanitary and objectionable. In order to dispose of the stick-water, which carries a considerable percentage of material which can be recovered as tankage, it is necessary to provide evaporators and to drive off the water as harmless steam, while the stick-water is concentrated into thick tankage and added to the product of the plant.

The products of a reduction plant are: grease, which may be classified, refined, and separated into various grades and sold for making soap and for other purposes; and tankage, which is useful in manufacturing fertilizer. If the operation is carried out on a sufficiently large scale, stated above to be not less than 100 tons per day, the profit is likely to be sufficient to make an attractive return on capital. In smaller quantities the reduction operation is almost sure to show a loss, unless all attempt to carry on the process inoffensively is abandoned and the foul and



CROSS-SECTION *of Sterling refuse and garbage destructor at Berkeley, California.*

PLAN *of Sterling refuse and garbage destructor at Berkeley, California.*



putrefying stick-water allowed to run away in the nearest stream. Small cities operating reduction plants are invariably burdened with a serious nuisance, as can be readily verified by inquiry among the inhabitants of such places.

The situation with regard to disposal of municipal wastes came to a crisis in Europe some years ago. In consequence, the most advanced methods of waste disposal originated across the ocean. The inhabitants of European cities waste far less of their food material than is the practice in America, so that the quantity of garbage per inhabitant is extremely small, and its value for reduction purposes is slight. There being no incentive, therefore, to separate garbage from other wastes, the plan was adopted of destroying the mixed refuse of the city in large high-temperature furnaces. The English destructor system, by which the entire waste collection of a city, or a portion of the city, is delivered to a destructor plant, and there burned under forced draft, in connection with steam boilers by which power is obtained from the waste heat, has now been widely adopted by cities thruout the world.

Many American cities have as yet done nothing in the direction of the sanitary disposal of municipal waste. Owing to the large free spaces which surround the smaller cities, it has usually been possible to carry on dumping operations, or feed the garbage to pigs, and to change the location of dumps when conditions become unbearable. Comparatively few of the smaller cities have been forced to instal incinerators for destroying garbage, or reduction plants for utilizing its values. But the time has already come when the conditions have become so serious that many cities are studying the best solution of the waste disposal problem. Since the reduction plant cannot be operated on a small scale without nuisance, except at a heavy cost for operation and maintenance, the simplicity and convenience of the incinerator makes the latter the only feasible apparatus for waste disposal in small cities.

Incinerators are intended to deal with garbage and rubbish as collected, and not to handle ashes or large quantities of noncombustible material. Two kinds of incinerators may be recognized. One attempts to provide storage space within the furnace for the entire day's collection of garbage, and to dry the wet mass slowly by heat previously accumulated in the furnace walls, and supplied by a coal or oil fire kept up in a combustion chamber below the material. The system has the ad-

CHARGING FURNACE *with garbage by means of grab-bucket.*

vantage of taking the entire day's collections at one time, thereby reducing the time and labor at the plant. It disadvantage is the impossibility of maintaining in the presence of the mass of wet material temperature sufficient to destroy the noxious odors. Incinerator plants of this character should be provided with tall chimneys, and are never safely located within the limits of a settled portion of the city.

Incinerator furnaces operating at high temperature have been successfully installed and operated in a number of cities. Such furnaces are constructed of fire-brick throughout. They provide a fire-brick surface on which the garbage and refuse may be charged in reasonable quantities at intervals of thirty to sixty minutes, and a fire grate on which quick combustion, at high temperature, may be kept up by firing the dry rubbish collected along with the garbage, or using coal or other fuel if the quantity of rubbish is deficient, or the collection too wet on account of rain. In the brick-lined destructor furnace it is possible to keep up a temperature above 1,250 degrees, and thereby to destroy organic gases, and positively prevent the escape of disagreeable odors from the plant.

Destructor furnaces may be used in connection with steam boilers, if desired, and steam power may thus be developed for any useful purpose. In this way large department stores and city buildings may utilize the waste material which is collectible in large quantities, and supply steam to the power plant of the building. Large works may dispose of rubbish of all kinds, including sweepings, restaurant scraps and every form of combustible waste, whether wet or dry, while realizing from the waste heat a large amount of steam power. In cities and towns up to populations of 25,000, destructor furnaces with steam boilers in connection, may provide power for municipal lighting, for sewage pumping, or for the heating of city buildings and other useful purposes.

Where the quantity of rubbish and garbage collected reaches upwards of one hundred tons per day of twenty-four hours, the English destructor system has marked advantages. The destructor receives and destroys all material collected, making it unnecessary to separate garbage from refuse and ashes, and requires only one collection instead of three. The temperature at which the material is destroyed precludes the possibility of creating a nuisance in the neighborhood. In the City of London, the Boro of Bermondsey has a destructor installed in a city block containing a school, a city building, a library and a number of residences, and surrounded by closely built blocks of resi-

FRONT *of garbage and refuse hopper, showing container system.*

dences on three sides. This particular destructor is now operating after some fifteen years use, at greater capacity than originally intended and is receiving the refuse collections from an adjacent boro as well as its own regular collections.

The high-temperature destructor consists of two or more separate cells or furnaces, each provided with a grate and a drying hearth at the rear. The forced draft is supplied to each cell by a perforated air pipe opening in the ash pit. The gases of combustion pass thru the cells from one to the next and enter a combustion chamber, in which the temperature may go as high as 2500 degrees. From the combustion chamber the gases are led thru the heating passages of a steam boiler, thence thru a regenerator or air heater and to the stack. The air for forced draft is taken generally from the roof spaces of the destructor house, thus providing efficient ventilation and means for the removal of dust. The ventilating ducts lead to the intake side of a pressure fan, by which the air is forced thru the heating passages of the regenerator and thence thru air pipes controlled by convenient valves to the perforated discharge pipes under the grates.

In the operation of a destructor, the garbage, refuse and ashes, mixed as received from the collecting wagons, is fired, either thru charging holes in the top of each cell, closed by sliding covers lined with fire brick, or thru doors in the back wall of each cell. The damp material falls on the drying hearth referred to previously, and is acted upon by the heat from the material burning furiously on the grate surface in front of the drying hearth. In this way vapor and fumes are driven off and consumed thoroly in the passage thru cells and combustion chamber. As the material on the drying hearth becomes dry, it takes fire and commences to burn rapidly. The stokers now pull forward the charge from the drying hearth and spread it over the grates, and introduce a new charge of fresh material upon the drying hearth.

The cells are operated alternately, so

that one is always burning brightly while another is being charged. In this way there is always sufficient heat and flame to destroy the escaping odors and vapors. As the material burns on the grates it forms a hard clinker, which must be removed from time to time by stoking.

Mechanical charging and clinkering devices have been developed with more or less success, for use in the larger plants. The most convenient method for stoking the garbage into the furnaces is the top-feeding system. The building for this method is preferably constructed against a side hill, on which a road can be laid giving access for wagons to the second or dumping floor of the building. The garbage in this way is dropped into hoppers above the furnace and raked from these hoppers into the charging cells as required. During the operation of charging, the blast must be shut off from the cell being charged, or flames may issue from the charging hole and ignite material in the hopper. To prevent such accidents, and for greater convenience in charging, mechanical charging mechanism has been developed, by which material required for one charge of a furnace is first placed in a container or bucket, which at the proper time is moved over the charging opening, the cover of the opening withdrawn, and the material allowed to fall into the cell below without handling or delay.

Where the top-charging system is not convenient, because no side hill is at hand and an inclined runway is not wanted, the garbage carts may dump on the floor level of the building, and the material may be carried by a grab bucket and crane from the receiving hopper to the charging containers above the furnace. A simpler method is to dump each garbage cart into a skip running on an inclined track. After receiving a load of garbage, the skip is hoisted by machinery to the top of the building and there dumped into a charging hopper, from which it is raked into the furnaces as required.

Clinkering a destructor furnace is gen-

FURNACE DOORS *of rubbish destructor, showing operation of removing clinkers from grates.*

erally performed by hand, and is an extremely difficult operation to perform by machinery. Destructor furnaces commonly receive all kinds of waste material, including pieces of wire, nails, glass, iron rods and other articles which often lock in the grate spaces or melt and run into solid masses of clinker, difficult to dislodge except by direct attack with a slice bar and poker. One method of mechanical clinkering is to provide the furnace with grates constructed in the form of a trough, and to lay in this trough a zig-zag iron bar which will become incorporated in the mass of clinker. When a large body of clinker is formed, a wire rope from a small windlass is hooked to a ring in the end of the bar and the whole mass drawn forward out of the furnace onto a steel car and thereby taken out of the building. Another method of clinkering is to provide a hydraulic plunger in the back of the furnace. By moving the plunger forward, the mass of clinker will be lifted and shoved out of the furnace to fall in the clinker car. Various forms of dumping grates have also been tried. But, at the present time, none of the mechanical systems of clinkering is in successful operation in the United States. The difficulties in the way of clinkering mechanism, thru the presence of foreign substances in the clinker, and the general difficulty of removing heavy masses of molten clinker and ash, have been insurmountable.

Destructor furnaces of the English type are in operation in a number of cities on the American continent, among which may be mentioned Montreal and Halifax in Canada, the Boro of Richmond in New York, Paterson, N. J., Pittsburgh, Pa., Berkeley, Cal., and others. There are several large plants under construction or test, and the use of the system will undoubtedly increase rapidly in the near future. Many cities are inquiring today for information regarding the plants already in operation, and much interest has been aroused by the performances of the many successful plants.

A destructor plant, housed in a neat and handsome building, is a source of pride to the municipality owning it. No nuisance whatever occurs from the operation of such a plant, if well managed. Deterioration is not rapid, nor is the apparatus complicated and difficult to handle. Ordinary laborers are easily taught to be successful stokers in such plants. By proper planning in advance, a destructor plant may always be located on a site conveniently near the centre of the collection district and at a point where the steam produced, or electricity generated by engines operated with the steam from the destructor boiler, may be used by the city or sold to adjoining private parties. In many cases the operation of destructors is found to be a source of profit sufficient to cover the cost of collecting garbage. As between the filthy and unsanitary method of dumping the garbage and rubbish collections on vacant lots, or feeding pigs in

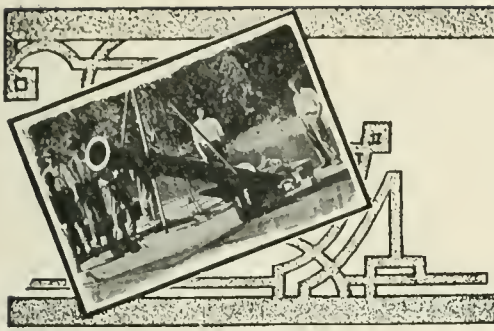
STERLING DESTRUCTOR *for garbage and refuse recently erected at Berkeley, California.*

municipal pens, and the efficient and sanitary disposal of rubbish and garbage in destructor plants, the choice is all in favor of the destructor system, and this system is the only one which can afford a profit in cities of moderate size.

The larger cities, in which the collection of garbage alone reaches seventy-five to one hundred tons per day, may with advantage consider the establishment of three collections, and the separate disposal of garbage, ashes and combusible rubbish. In these cities, a destructor finds employment for burning the unsalable waste rubbish, as in the cities of Pittsburgh and Buffalo. Ashes being disposed of by dumping, and garbage by shipment to a reduction plant, the remaining rubbish can be sorted over a picking belt and separated into salable and unsalable portions. The worthless rubbish burned in high-temperature destructors furnishes power for the operation of the picking belt, and a surplus of electricity for lighting and for sale to other plants in the neighborhood. A further economy is possible, though not yet adopted by any American city. This is to utilize the worthless combustible refuse for furnishing heat to the reduction plant. This may be done either by baling the worthless refuse after sorting, and shipping it to the garbage plant, for which purpose it would be worth as much as coal at $2 per ton; or by delivering all the rubbish to the reduction plant, and there picking out the salable portions. In the average city collections, there is enough heat obtainable from the rubbish to provide most of the heat necessary in the reduction operation.

Economic Side of Good Roads Days

The other day the Governor of the State of Idaho, two ex-Governors, the Mayor of Caldwell, bankers, professional men, merchants, and well-to-do citizens generally, to the number of 300, donned overalls, shouldered picks and shovels and sallied forth to do a bit of road work in the neighborhood of Caldwell. It must have been a grand and inspiring sight to see these men with soft hands and untrained muscles going valiantly to show by their works their faith in the good roads movement, and incidentally to garner a bounteous harvest of blisters, sunburn and backache. It is safe to say that not more than 5 per cent. of those volunteers was efficient or even practiced in the handling of pick and shovel. That is, fifteen of them could do a full day of effective work without going to the hospital afterward, and the other 285 just cluttered up the ground and were more or less in the way. It also is a safe guess that the one day of work represnted as costly a bit of road-building as has been done anywhere in this land of wasteful effort. Taking the average earning capacity of the volunteer shovelers and pickists, in their own vocations, at ten dollars a day—certainly a conservative estimate for such men—the cost of that one day's work, in wages alone, was $3,000. Fifty practiced and efficient shovelers could have done more and better work in the same time and at a wage of only $150. But we must have spectacle and hoorah, brass band and tinsel, or we feel the entertainment committee is not doing its duty. It would not have been enough like a show for the governor, et al, to make up a purse of $3,000, hand it to some competent road-maker and ask him to get the most for the money. For example, $3,000 would have paid the highest of wages to the fifty expert shovelers for twenty days. Yet, with such spectacular, inefficient, wasteful, and unbusinesslike exhibitions before us every day in all parts of the land, we wonder why we do not get more substantial results from our taxes and other expenditures, and why it costs us so much more to live than it did our fathers.—*Engineering-Contractor.*



EDITORIAL

FIRE PREVENTION.

The Fire Underwriters are pointing the moral of the Salem fire by showing that everything which happened was predicted in their report on the fire hazards of the city and that if their recommendations had been followed the conflagration would have been prevented. An asbestos roof saved one factory. Automatic sprinklers prevented complete burning of the contents of three reinforced concrete factories which had caught fire from outside. A brick wall stopped the spread of the fire in one direction. Wire-glass windows kept the fire out of one power house and one factory.

These are the bright spots in the story of the burning of a district with frame factories and dwellings, shingle roofs on brick and concrete buildings, carelessness in handling dangerous materials, only nine firemen on duty, defective hydrant, reduction of water pressure with breakage of sprinkler feeders in two burned factories and no gates to shut them off, poor water supply thru small distribution reservoir and small distribution pipes, cement pipes preventing high pressure connection with the Peabody supply, low tide in canal, preventing use of that supply by steamers from other towns and cities not equipped to use style of hydrants in Salem.

The combination of hot weather, high wind and delay in first attack of fire or any two of them will produce a conflagration in a wooden town. Salem had all three. Fire-proof buildings in groups will not stop a fire under such conditions, because brands spread it thru long distance jumps.

Cities are often slow to heed the recommendations of the National Board of Fire Underwriters and its engineers, and protest because insurance rates are not decreased or are increased pending their action upon such recommendations. The possible consequences of such neglect are shown by Salem's disaster and the good judgment of the Underwriters in delaying reductions in rates until the improvements in public fire protection and in private fire prevention are fully installed is clearly demonstrated. Will other cities move any more quickly because of these demonstrations?

ANCIENT COMMISSION GOVERNMENT OF CITIES.

The commission form of government of cities has been shown to be much older than that established in Galveston, which has been the moving cause of the rapid spread of this form of municipal government within the past ten years, but now comes the Civic Government League of Edmonton, Alberta, and demonstrates that it is over seven hundred years old, by

quoting from King John's charter to the boro of Northampton, England, in 1200, as follows:

"We decree also that in the said burgh of Northampton there shall be elected by common choice of the burghers, four of the more learned and discreet citizens, who shall care for the revenues of the Crown and other matters which to us and our Crown in that burgh pertain, and who shall see to it that the citizens of the said burgh, both rich and poor, shall act justly and according to law."

Many other English city charters are in similar form and the most modern development is back to this early form. The more "democratic" form of government which has prevailed in American cities since the founding of the United States seems to be less efficient and to be more or less discredited on that account. Mr. Carl Gayler, before the St. Louis Engineers' Club, recently presented a rather intemperate defense of this democratic form, which had some effect in modifying details in the proposed new St. Louis charter, but did not modify its general principles. However, while it is less democratic than the common form of city government, the St. Louis charter does not provide for the full commission form, but for a modified form, which will probably be more satisfactory for so large a city. It has just been adopted by a small majority.

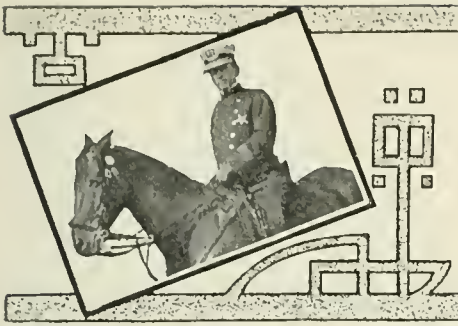
CHICAGO'S INVESTIGATION OF TERMINALS.

A body of representatives of the city of Chicago is at present in Europe engaged in a study of railroad terminal problems, at least this subject is reported to constitute the main purpose of the trip. Other subjects, such as the vice question, will also receive attention during the trip.

Chicago has been liberal in its investigations of various problems but, in spite of such studies, it does not seem to be making material progress in developments or improvements. The present investigation of terminal problems in Europe with a view to applying the result of the study in the perfection of a plan for solving Chicago's terminal problem does not seem to be founded upon good judgment. Chicago is the world's greatest railroad center and the physical operation of its terminals is probably more complex than that of the terminals of any other city in the world. Basic principles which serve satisfactorily in the case of London or Paris could hardly be applied in Chicago. Chicago's problem is individual. It must eventually be solved by the application of sane and economic principles in which not only the city government but the railroads themselves could reasonably concur.

It is a well-known fact that electrification has been much discussed in Chicago, especially among politicians, as a panacea for all the ills and inconveniences of steam operation and also as the basis upon which a comprehensive terminal plan could be developed. If it is possible to judge by the progress which has been made by the electrification of steam railroads thruout the world, it is evident that electrification is still in its infancy and it is probable that many important modifications of present methods may be made within the next decade or so.

Our judgment is that Chicago could more profitably engage in an intelligent study of the engineering, financial and operating problems involved in its railroad and terminal situation, work in connection with which could be better conducted at home than upon any vacation tour, no matter how well conducted or well financed.



QUESTION DEPARTMENT

Proposed Municipal Creosoting Plant

We would like data as to a creosoted block plant capable of turning out enough blocks a day to cover 1,000 square yards. There is an endeavor to establish such a plant at the city workhouse in a certain city.

T., Chicago, Ill.

A plant simply for creosoting blocks only is a comparatively simple affair, containing space for lumber, a sawmill, tanks for holding the oil and for heating it when necessary, the pressure cylinder and cages and tracks for handling blocks in and out of it, air pumps for exhausting air from cylinders, pumps for putting pressure on the cylinders and pumping oil, water and steam, a steam plant sufficient to furnish steam for the process, as well as for operating the machinery.

If the oil must be prepared, stills for that purpose must also be provided.

The amount of unskilled labor required about such a plant is rather small, especially one of the capacity named.

The plant should be specially designed by an expert and one should be consulted in making the preliminary plans and estimates.

E. B. Badger & Sons Co., 75 Pitts street, Boston, Mass.; Eppinger & Russell Co., 165 Broadway, N. Y.; S. P. Sharples, Barrett Mfg. Co., Boston, Mass., can give information and aid in the study of the problem.

Village Wants A Water Supply

Our village has a population of less than 2,000, with water 16 to 25 feet from surface of ground, which here is sand and gravel; well can be driven and yielding water in less than an hour fit for domestic use. Do you think it probable we can get any company to take a franchise here to supply water to the inhabitants and for fire protection, street sprinkling, etc.? M., ————, Ill.

The village itself wants water for fire protection, street sprinkling, fountains, school and other public buildings. Some of the inhabitants want water for domestic purposes. The process in the past has been to grant a franchise to some one to furnish the water on terms dictated by him and to allow him to take all the risk and all the profit. Since the establishment of state public service commissions the process is not so satisfactory, since the state commission can step in and modify rates at any time and may not allow the profits which the holders of the franchise think are due them. It is, therefore, necessary to reduce the amount of risk in assuming the obligations of the franchise to conform with the diminution in the possibilities for large profits.

The village can do this by making a preliminary plan and estimate of cost of building and operating the plant and getting some idea of the revenue which can be developed from private consumers.

The revenues must meet the expenses and capital charges and whatever the revenues from private customers lack of doing this must be raised. If the desire of the village for the water supply is strong enough, the village board can agree to pay enough for fire protection and public uses of water to meet the deficiency. If this annual payment by the village is more than its fair share of the total annual charges to be met, it can be reduced from year to year, as the income from private consumers increases, until a fixed minimum is reached; after which any excess in receipts over charges can be divided between company, private consumers and village at large in a manner to be agreed upon.

An agreement made on these general lines removes all uncertainties, so far as the investor in the plant is concerned, and it should therefore be easy to find some person or company who will be willing to make the contract and build and operate the plant.

What the village needs first, therefore, is an engineer experienced in modern contracts and franchises who can make the preliminary plans and estimates and prepare the form of contract or franchise. His fee will be well invested and will save the village and its citizens many times the amount, if, indeed, under present conditions, it does not turn an impossibility into a satisfactory reality.

Municipal Quarries

We are desirous of finding out what cities, either in the United States or abroad, have municipal quarries. We would like, also, if possible, to find out whether these have been successful or not. We will appreciate any information you can send us in this respect.

J. D. R.,
Minneapolis, Minn.

The latest report by the Bureau of Census on general statistics of cities for 1909 reports the following municipal quarries in the United States:

St. Louis, Mo., and Nashville, Tenn., each moved over 64,000 cubic yards of stone from their quarries; Oakland, Cal., and Washington, D. C., over 25,000; San Antonio, Tex., Everett, Mass., Auburn, N. Y., over 15,000; Somerville, Mass., and Rockford, Ill., over 10,000; Atlanta, Ga., Louisville, Ky., Quincy, Ill., Augusta, Ga., Newton, Mass., and Manchester, N. H., over 5,000; Haverhill, Mass., Kansas City, Mo., Duluth, Minn., over 2,000, and Kansas City, Kan., and Dubuque, Ia., less than 1,000. San Antonio, Tex., is reported to have sold $600 worth of stone in 1911, but no other city gives either receipts from stone sold or cost of operating quarries.

Ordinances Providing For Vehicle Licenses

Can you give us any information in regard to "wheel tax" ordinances, ordinances taxing vehicles for the maintenance and repair of the streets? We should like to know what cities have such an ordinance now in operation; whether or not there are ordinances of this nature, which do not make provision for using the income for the maintenance of streets, and what the usual rates are.

M., Madison, Wis.

The number of cities assessing vehicle license taxes is not large. Of the 193 cities of over 30,000 population included in the United States Census report of financial statistics of cities for 1911, only 29 are reported as collecting license fees for horse-drawn vehicles, from which they derived $1,112,469 of revenue.

Twenty licensed automobiles and fifteen motorcycles, collecting $59,524. Four licensed motor operators, collecting $6,338. The returns for 1912 show somewhat less revenues in that year.

The names of cities collecting vehicle licenses are not given definitely, but the following seem to have such ordinances; there may be a few more: Chicago, Ill.; St. Louis, Mo.; Pittsburg, Pa.; Buffalo, N. Y.; Cincinnati, O.; Los Angeles, Cal.; New Orleans, La.; Washington D. C.; Kansas City, Mo.; Indianapolis, Ind.; Louisville, Ky.; Denver, Colo.; Portland, Ore.; Columbus, O.; Oakland, Cal.; Birmingham, Ala.; Dayton, O.; Spokane, Wash.; San Antonio, Tex.; Kansas City, Kan.; Duluth, Minn.; St. Joseph, Mo.; Oklahoma City, Okla.; Evansville, Ind.; Jacksonville, Fla.; East St. Louis, Ill.; South Bend, Ind.; Wichita, Kan.; Covington, Ky.; Mobile, Ala.; Springfield, O.; Little Rock, Ark.; Wheeling, W. Va.; Galveston, Tex.; Elmira, N. Y.; Hamilton, O.; Quincy, Ill.; Charlotte, N. C.; Newport, Ky.

Some of these license automobiles only. Some of them license horse-drawn vehicles and not automobiles; thus the cities in Indiana are prohibited from charging license taxes on automobiles, the state collecting them.

Whether the proceeds are used in maintaining streets depends on constitutional provisions and on the needs of the city in other directions. In some states all the proceeds of licenses must go to certain designated funds or to the general fund. In the latter case the fund can be appropriated for street maintenance. Oklahoma City passed an ordinance charging license fees on automobiles and appropriating the receipts to maintain a certain named boulevard. Not many states give their cities as great freedom as this. The proceeds as reported in MUNICIPAL ENGINEERING, vol. xliii, p. 260, were estimated at $12 000 a year.

The city of Cincinnati, O., probably has the most elaborate and inclusive ordinances regulating vehicle traffic and copy of that ordinance will answer most of the questions that may arise.

The following rates from the Indianapolis ordinance may be taken as typical.

Wagon or truck for hauling boilers, machinery, safes or stone and drawn by 4 or more horses, $20; by 2 horses, $15; for hauling logs, lumber, brick or ice, 2 horses, $8; 1 horse $5; 4-horse omnibus, $10; 2-horse, $8; 4-horse tallyho, $10; 2-horse, $8; 4-horse wagon not used as above, $8; 2-horse $5; 1-horse $3; 2-horse dray or truck, $5; 1-horse, $3; 2-horse furniture car, $7; 1-horse, $4; 2-horse sprinkling cart, $8; 1-horse, $5; 2-horse hack or hackney carriage, $6; 2-horse barouche, coupe, rockaway, trap, cab or surrey, $5; 1-horse family surrey, $2; horseless carriage, $3; 1-horse surrey or vehicle for delivery or hauling purposes other than above described, $3; 1-horse or pony driving cart, $2; push or hand cart, $2; bicycle, except for children under 14 years, $1; 1-horse vehicle not above mentioned, $3; 2-horse, $5; 3-horse, $6; 4-horse, $8.

Numbers are required and plates are described, and are furnished with the licenses.

Lights at night, widths of tires for iron and for wooden axles are prescribed.

Automobiles are not licensed because the state licenses them and prohibits licensing by cities.

WORKERS IN THE FIELD

Burned Asphalt Can Be Prevented

The Editor of MUNICIPAL ENGINEERING:

Sir—In the July issue of your journal, on page 49, is an article entitled "Burned Asphalt Cement Can Be Prevented." Inasmuch as this article does not bear the name of a contribntor, we must presnme that it is editorial, and as the inference to be drawn from it is that unless asphalt be melted by steam it will be burned, we ask permission to say a few words upon this subject. The use of steam as a melting agent for asphalt is not by any means a new idea; in fact, it is about as old as the asphalt paving industry itself, and has been experimented with both in paving plants and in refineries. Careful laboratory experiments have also been made along that line, the details of which will not be gone into here, but the results were such as to warrant doubt of the statement that steam at a boiler pressure of 125 pounds, not superheated, will raise the temperature of asphaltic cement to 350 degrees Fahr., unless some auxiliary or secondary means of assisting the steam heat be nsed in connection therewith.

Asphalt melting kettles have been superimposed over the settings of sand heaters in such manner that the surplus heat from the fires of the sand heaters acted upon the shells of the kettles from below and thus formed heating means auxiliary to steam melting coils arranged upon the insides of the kettles, but in a strict sense of the term this cannot be called steam melting; rather it ought to be termed combination melting, inasmnch as the heat comes from both the steam coils and from the fires below the kettles.

According to the tables relating to the properties of steam, found in Kent's Engineer's Hand Book, the Fahrenheit temperature of steam at a boiler pressure of 125.3 pounds is 352.8 degrees. Inasmuch as it is a well-known fact that a very considerable percentage of loss is occasioned between the boiler and the melting kettle, it is difficult to understand how you can obtain 350 degrees temperature in your asphaltic cement from steam at 125 pounds boiler pressure, and practically the same temperature. We would be glad of enlightenment upon this point.

Your article states that with steam at 125 pounds pressure your asphalt "cannot exceed 350 degrees," but the real question is this: Can you obtain 350 degrees of temperature from steam at 125 pounds pressnre without outside assistance from another source of heat?

In this article you also make this direct statement: "All asphalt coming in contact with the part of a melting kettle nearest the fire is burned in spite of any agitation given it."

According to this statement, all of that vast amount of sheet asphalt pavement that has been laid in the past has been made from mixtures in which the asphaltic ingredients have been burned. Now, while it is true that an arrangement in which a melting kettle in an asphalt plant is set directly over the fires may be such that the contents of the kettle will burn, yet it is also true that the builders of the best types of modern plants do not follow that practice, but so separate the fires from the kettles by interposing walls that burning of the asphaltic material is practically impossible if the melting operations are under the charge of an ordinarily intelligent operative, and there is no more reason why the asphalt should he burned than there is that the water should be permitted to get too low in the boiler and the boiler explode.

There are certain advantages connected with steam melting which appeal to the designer of asphalt paving plants, the principal one being that if fireplaces are dispensed with more room will remain for melting capacity in the same amount of space; but also there are serious disadvantages, and the plant designer must exercise his judgment as to which method or process will produce the best results. The point should not be overlooked that whichever means of melting be employed, coal will be the original source of the heat, and it is an axiom in mechanical engineering that the more removes from the

coal pile the greater the loss of efficiency.

F. A. HETHERINGTON,
Indianapolis, Ind.

The article referred to was contributed and not an editorial expression, the editorial department being directly responsible only for material in the editorial department or otherwise bearing the statement that it is prepared under its direction. The attempt is made to admit to any part of the magazine only material which is based upon fact or which will throw light upon debatable questions, but there are great differences of opinion and even of observations of fact, and so the lines cannot be drawn too closely. The editorial department is always anxious to present all sides of any question on which there may be differences of opinion, and therefore welcomes both the original article and Mr. Hetherington's discussion of it.

A careful reading of the article in the July number will show that it was carefully written, so that it does not misstate facts. Mr. Hetherington's additions to the supply of facts are pertinent, however, and call attention to points which might be overlooked in a casual reading of the earlier article.

Septic Tank vs. Imhoff Tank.

The Editor of MUNICIPAL ENGINEERING:

Sir—In a letter published in your issue for June last, under the heading, "A Word for the Much Abused Septic Tank," attention is called to the many and varied reasons for so-called septic tank failures, and the statement is confidently made that "no septic tank which is properly designed with due regard to the character and volume of sewage to be treated, and in which the fundamental principles of the septic process are correctly applied, will fail to operate successfully and do all that can be reasonably claimed for it; and further, that such an installation is not only the most economical in first cost and operating expense, but the most efficient method of sewage disposal that is known today."

This is a broad statement, in view of the opinions we occasionally see expressed in the technical journals, that the septic tank does not accomplish what was originally claimed for it, but it is none the less true, and from the remarkable efficiency of plants that have been installed along correct lines in this and other countries, we can only infer that these disparaging remarks are but the logical result of unwise experiments with tanks in which the fundamental principles of the septic process have been ignored.

These unsatisfactory experments are so numerous, however, that in many localities the septic tank is positively condemned, and it is not surprising that many municipalities have been induced to adopt Imhoff tanks.

The Imhoff, or two-story septic tank, is very similar to its predecessor, the Travis or Hampton tank, and is distinguished therefrom only in an arrangement of baffles on which Dr. Imhoff has secured U. S. patent, and is demanding substantial royalties.

While insisting on a recognition of Cameron's septic process patent in connection with the Imhoff tank, the Cameron Company have freely admitted that there is no conflict between the two patents, inasmuch as the Imhoff patent covers merely the apparatus peculiar to the Imhoff type of two-story septic tank, whereas the Cameron patent covers the basis process, without infringing upon which the Imhoff tank cannot be used.

Dr. Imhoff has admitted that his patent in no sense covers the process involved in its operation, and has very frankly told the writer that prospective users of his device were so advised by the engineers who are exploiting the Imhoff tank.

The Imhoff tank, it may be explained, is simply another experimental adaptation of the septic process; it differs, however, from the single-story septic tank in that:

1. On account of its great depth it costs two or three times as much as a single-story tank of equal capacity.

2. The solid matter stored in the lower compartment of the Imhoff, or two-story tank, requires frequent removal, whereas in the single-story septic tank, when properly installed, the organic solids are completely liquified by undisturbed anaerobic action, and there are no excessive accumulations of partially disintegrated organic matter to be removed.

3. The Imhoff tank requires almost constant expert attention, whereas the single-story septic tank requires little or none.

As to their relative efficiency, it does not require a great amount of technical knowledge to determine the character of liquid effluent to be expected from the two types of tanks. The rest-period, or length of time the liquid sewage remains in each, is approximately as follows: Single-story tank, 16 to 24 hours; Imhoff, or two-story tank, 2 hours.

For a practical demonstration, fill two vessels with crude sewage, allow one to setlle for a period of two hours, the other for from 16 to 24 hours, decant the liquids, apply any reliable test and their relative clarity can be easily determined.

It has occasionally been claimed by advocates of the two-story tank, that the longer stay of liquids in the single-story tank is detrimental to the effluent by reason of its becoming 'septicized'; this is true only as a result either of improperly arranged inlets and outlets, the introduc-

tion of unnecessary baffles, or other defective design as was suggested in my former letter; these defects are the cause of the bad odors so often complained of, and which are entirely unnecessary in a properly designed single-story septic tank.

H. D. WYLLIE,
Chicago, Ill.

Individual Septic Tanks

The Editor of MUNICIPAL ENGINEERING:

Sir.—In your July number on page 35 I note an inquiry regarding individual septic tanks. Thru our St. Louis representatives, the Barks & Barstow Mfg. Co., we have on the market a small Cameron septic tank for individual residences, country homes, etc., which we believe to be superior to anything of the kind yet introduced; it is described in a pamphlet sent you herewith. H. D. WYLLIE,
Chicago, Ill.

The pamphlet describes the methods of applying the septic process in two stages, the first or liquefying stage proceeding in the septic tank and the second or aeration and filtration stage proceeding in an aerator and filter tank. It may also proceed without the aerator and filter tank by using a system of sub-irrigation and underdrainage, which is quite fully described. Specifications are also given for the construction of the septic tank, and the filter tank with its aerator, and for the valves and valve chamber, in case sub-irrigation is used.

Municipal Swimming Pools

The Editor of MUNICIPAL ENGINEERING:

Sir—For information of C., Decatur, Ga., whose inquiry is on p. 35 of the July number of MUNICIPAL ENGINEERING, enclosed find clipping from the Pittsburgh Sun of July 20, 1914, also photographs showing the boys in action in what we think the best and largest swimming pool in the United States.

We are going to have some photos taken next month showing our bath house and play grounds adjacent to swimming pool, and will be glad to send him one or any other information he may desire.

ARCHIE DUNCAN,
Superintendent of Parks and Public Property, McKeesport, Pa.

Following is the description of the pool referred to:

With a new fountain playing in its center and numerous improvements which make it one of the largest and finest swimming pools in the country, the great bathing basin of McKeesport, on the banks of the Youghiogheny River, is attracting thousands these hot midsummer days.

Meanwhile, in the newly laid out play ground at one side of the immense bath, hundreds of children disport themselves. Daily, from morning until after dark, men and boys, women and girls of the Tube City flock to the pool. Hundreds are in the water at one time, their heads bobbing over the surface. Daily, too, come other thousands to watch this sport in the water, from the tiers of benches which line two sides of the basin.

Bath houses, showers, diving boards and chutes add to the joy of the bathers, and are kept in constant use. Guards are continually on duty, and no bather has been drowned since the opening of the pool. Only a short distance away is the Youghiogheny River, neglected by the bathers who once splashed and swam in it.

Women take possession of the pool

Thursdays of each week. No men are permitted in the vicinity that day. The capacity of the place is taxed to its limit, guards say. More time soon will be demanded by the women of McKeesport, it is said, to enjoy the delights of the swimming pool.

Already this summer the average attendance per week is estimated at 5,000. The pool opened June 9, and for the remainder of that month 16,000 bathed in its waters. The average daily attendance is approximately 1,000. During women's day between 600 and 800 women attend. Sundays the general attendance is practically doubled, fully 2 000 people crowding the pool from the time it opens, at 8 o'clock in the morning, until its close at 9 o'clock in the evening.

Before the pool was established upon its present basis drownings in the Youghiogheny and Monongahela Rivers averaged twelve each season. No drownings have been reported in recent years, owing, it is believed, to the fact that the rivers have been deserted for the pool by bathers.

It is estimated that more than 700 persons are taught to swim annually in the basin. Three men are on duty continually as guards and swimming instructors, and one woman. On Thursdays two women instructors are employed.

In a recent investigation, studying such institutions, conducted by the University of Wisconsin, McKeesport received high praise for its pool, which was pronounced unequaled, of its kind, in the country.

Archie Duncan, member of the city commission of McKeesport, and head of the department of parks and public properties, has made the big pool his especial charge. Thru him were made most of the improvements that have been added in the last year and in previous years. Thru his solicitation, the National Tube Company placed the greater part of the apparatus in the pool, including the chutes, swings, carrousels, bath houses and cold showers. In all, it is estimated that the company has expended approximately $17,000 upon the pool. The cost to the city has been chiefly maintenance.

The bathing basin was installed five years ago. Since then it has been enlarged. Now its concrete lining covers a space of 234 by 260 feet. It has been graded carefully, so that there is a section in which children can paddle about without danger. In another section high diving may be done with safety. The depth of water varies from six inches in the east end to nine feet in the west end. Water for the pool is pumped from the Youghiogheny River after being filtered.

William H. Coleman, present clerk of courts, is credited with having taken the first definite step in the development of the pool. That was during his term as mayor of McKeesport, which ended in April, 1909. At that time excavations had been made and at the close of his term Mr. Coleman donated $500 of his salary to pay for cementing the bottom.

Last year more than 50,000 bathers enjoyed the benefits of the pool, it is estimated. That this number will be exceeded materially before the close of the present season is believed by the McKeesport authorities.

The Editor of MUNICIPAL ENGINEERING:

Sir—Denver has had a municipal bath house with a swimming pool for several years. It also has swimming pools in three or more of the lakes in city parks and is considering the placing of one or more in addition in other lakes. There was a swimming contest in the lake at Washington Park on the Fourth of July.

Besides the swimming pools there are also wading pools in the Sunken Gardens, Cheesman Park and others, which are for the little ones too young to swim.

W. A. PECK. C. E.,
Denver, Colo.

P. H. Weathers, architect, Oklahoma City, Okla., calls attention to the municipal baths at Guthrie, Okla., a very modern institution, which doubtless includes a swimming pool, probably not open like those in the cities named in the answer to "C" and in the communication above.

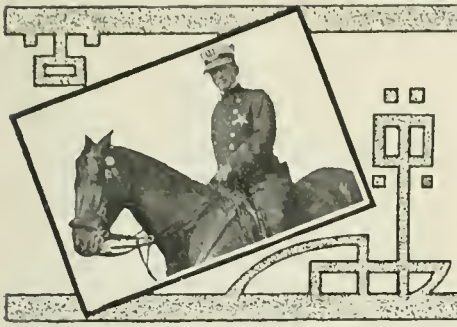
The latest number of *Public Affairs*, the bulletin of the Civic League of St. Louis, Mo., contains a photograph of Fairground Pool, which is also said to be the largest artificial out-of-door swimming pool in the world. It is the only public swimming pool in St. Louis, and opened its second season on June 12. It holds almost 4 000,000 gallons of water and accommodates 2,500 bathers at one time.

Ordinance Prohibiting Free Lunch With Sale of Liquors

The Editor of MUNICIPAL ENGINEERING:

Sir—I see in your July issue, p. 34, the request to have some of your readers inform you if any ordinance prohibiting free lunch with the sale of liquor has been put to test. It may therefore interest you to know that the city of St. Paul, Minn., has had such a law enforced for many years.

P. H. HANSEN.
Chicago, Ill.



LEGAL DECISIONS

Decisions of the Higher Courts of Interest to Municipalities

Tenat Must Pay Water Rent—Ordinance to Contrary Unjust—An ordinance enacted by a city, authorized to furnish water to its inhabitants, requiring all assessments for unmetered water consumers to be assessed against the owners of the property, instead of the consumers, is unjust, unreasonable, and an arbitrary distinction between the inhabitants, so as to be void; another by-law, which required all unmetered assessments to be paid in advance, furnishing all necessary protection to the city. At common law a landlord is under no obligation to furnish water to his tenant; nor is a tenant bound to pay water rent, in the absence of agreement. Farmer v. Mayor, et al. of Nashville (Tenn.) 156 S. W., 189.

Ci y Must Provide Outlet for Surface Water in Improving Street—A municipal corporation has the right to improve and provide for the drainage of its streets; but, if in so doing it causes an increased flow of surface water upon or against private property, and negligently fails to provide a sufficient outlet for the escape of the water thus brought upon or against such property, it will be liable to the owner thereof for any damage that may result from such negligence. Naysmith v. City of Auburn (Neb.), 146 N. W., 971.

City Liable for Damage from Breaking of Water Tank or Reservoir—A city is liable for injury caused by the breaking of its tank or reservoir in which it has collected water in large quantity to supply its waterworks system. In the absence of proof that the breaking of the tank was caused by some superior force, such as an unusual and violent disturbance of the elements or an explosion clandestinely caused, negligence will be inferred from the breaking. Restriction upon a city by its charter in the rate of water rent which it may lawfully charge consumers does not affect the question of its liability. Three cases: Wigal, Wigal, and Jackson v. City of Parkersburg, (W. Va.), 81 S. E. pp. 554, 558, 559.

City May Provide for Future Private Lighting—Tax Rate Limit and Bond Interest.—A city, authorized by statute to construct an electric lighting system and issue bonds therefor, may provide for the construction of a public lighting system in such a way that private lighting may be subsequently added, tho the plant so constructed may be more expensive than one constructed solely for public lighting. The mere fact that the interest on bonds issued for a public lighting system and the costs of maintenance will so swell the city tax rate as to exceed the tax limit does not alone show that the tax limit will be exceeded, since a sufficient saving may be effected by the system and thereby offset the increase. Livermore v. Mayor, etc., of City of Nullville, et al. (N. J.), 90 Atl. 380.

Liability of Water Company for Fire Loss.—In an action against the proprietor of a water plant, evidence held to show that when its agent told a consumer that he would be furnished water for all purposes, neither party contemplated the furnishing of water for fire protection, and hence it was not liable for its failure to furnish water for such purpose; it appearing that the city government had assumed the burden of fire protection. An individual or company authorized to do so may so contract as to incur a liability for damages proximately resulting from a failure to furnish water sufficient to extinguish fires. Dublin Electric and Gas Co. v. Thompson, (Tex.), 166 S. W. 113.

Liability for Injury on Sidewalk Constructed on an embankment. The fact that a sidewalk was constructed upon an embankment 2 feet high, with a gentle slope of 3½ feet to the bottom thereof, nor that the walk was about 4 inches above the level of the top of the embankment, make the place a dangerous one, so as to require the erection of barriers by the town for the protection of persons using the walk. The construction of a sidewalk with its edge about

four inches above the surface of the ground at the side of the walk does not render the walk unsafe for travel, so as to make the town liable for injuries received by one who stepped off the walk. Town of Elsmere (Ky.) v. Tanner, 166 S. W., 220.

Liability for Injury on Part of Street not Improved.—Where a strip in the center of a platted street had been cut down to the established grade, leaving the remainder thereof about six feet above the grade, the city extended no invitation to the public to use that portion which had not been graded, and therefore was not liable for injuries received by one who was coming down a path from the top of the bank to the graded portion of the street. Robinson v. Kansas City, et al. (Mo.), 166 S. W. 343.

Validity of St. Louis Method of Assessing Cost of Street Improvement Affirmed. —St. Louis Charter, art. 6, § 14, requiring the assessment of one-fourth of the whole cost of improving streets on the property fronting on the improvement, in proportion to frontage, and that the remaining three-fourths shall be assessed on all the property in the district bounded by drawing a line midway between the street to be improved and the next parallel or converging street, and providing that if the property is divided into lots, the district line shall be drawn so as to include the entire depth of the lots fronting on the street, while causing an inequality of assessment where part of the property is laid out into lots and part is unplatted property extending a long distance over to another street, is not invalid as working a deprivation of property without due process, contrary to federal Constitution, amendment 14. Loth et al. v. City of St. Louis et al. (Mo.), 165 S. W. 1023.

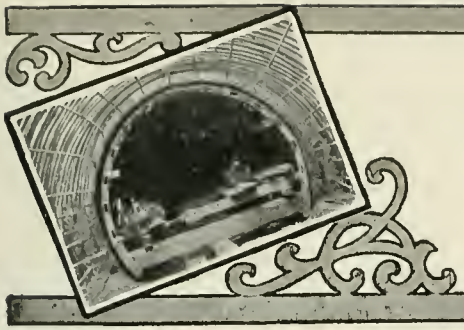
Liability for Damage to Property by Sewer Excavation.—The failure of a sewer contractor to notify a property owner of his intention to excavate near and below the level of the foundation of the owner's building was actionable negligence, if injury resulted from such excavation. A contractor, suing to recover from a city one-half of a judgment against the contractor and a city, which the contractor was compelled to pay, for injuries to property abutting on an alley by the contractor's omission to give notice to the owner of intention to excavate, cannot escape liability on the ground that there was a discrepancy between the actual width of the alley and that given to it in the specifications, since, unless the contract covered the excavation causing the injury, the contractor had no authority to make it, and hence the contractor cannot recover herein. Wanger et al. v. Marr et al. (Mo.), 165 S. W., 1032.

City Can Build Competing Water Works.—The property of a private waterworks company is not taken contrary to U. S. Const., 14th Amend., by the municipal construction of a competing plant, where there is no contract immunity from such competition, altho the water works company may be forbidden by the local law to divert its property to other uses, and will be called upon to pay taxes to help its rival to succeed. Madera Water Works v. City of Madera (Cal.), 33 Sup. Ct. 571.

Changes in Plans for Sewer After Letting do not Vitiate Contract.—Material changes in the construction of a district sewer in a city, made after the letting of the contract, by shortening one of the ditches called for and by adding laterals at places not called for, necessary to proper drainage for the entire district, were proper in view of the duty of the city to construct the sewer so as to properly accommodate the property owners of the district, and did not affect the validity of the special tax bills, especially as the contract provided for changes in the work with proportionate alteration in the price. Changes in the grade of the main pipe of a district sewer in a city lessening the cost of the work without impairing the service to be rendered do not vitiate the contract or the special tax bills. Stover et al. v. City of Springfield, Mo., 152 S. W., 122.

Sewer Assessment Liability on Owner at Time Sewer was Ordered—An assessment of benefits for the construction of a sewer is a lien on the land covered by it, which dates back to the time of the order for the construction of the sewer and is an incumbrance from that time. The court, on certiorari to quash a sewer assessment levied nearly seventeen years after the building of the sewer, will not grant relief on the ground of delay, where it does not appear that the petitioner has suffered thereby. Hester v. Thompson, tax collector, et al., (Mass.) 105 N. E., 631.

Eminent Domain Power Transferable to Agents—The Legislature has, by necessary implication from its various acts giving to municipalities a right to obtain a water supply, granted to them the state's right in so much water to be taken from the streams of the state as they may need for their lawful purposes. Municipalities having the right by implied grant from the state to appropriate water from streams for their lawful uses and purposes can contract with water companies to supply such water, and thus make them their agents or instrumentalities for that purposes. Under Act 1888, authorizing municipalities to contract with water companies to supply them with water, a water company with whom a municipality has so contracted may delegate its agency or contract to another. Wilson, Atty. Gen. v. East Jersey Water Co., (N. J.) 90 Atl., 728.



SANITATION

Borax Will Prevent Breeding of Flies

As a result of experiments, the specialists of the Department of Agriculture have discovered that a small amount of ordinary borax sprinkled daily on manure, will effectively prevent the breeding of the typhoid or house fly. Similarly, the same substance applied to garbage, refuse, open toilets, damp floors and crevices in stables, cellars or markets, will prevent fly eggs from hatching. Borax will not kill the adult fly nor prevent it from laying eggs, but its thoro use will prevent any further breeding. While the "Swat the fly campaign," traps and other devices for reducing the number of typhoid-carrying flies are of value, they are of less importance than the prevention of the breeding.

The investigators found that 0.62 of a pound of borax, or 0.75 of a pound of calcined colemanite (crude calcium borate) would kill the maggots and prevent practically all of the flies ordinarily breeding in eight bushels of horse manure from developing.

In the case of garbage cans or refuse piles 2 ounces of borax or calcined colemanite, costing from 5 cents a pound upward, according to the quantity which is purchased, will effectually prevent flies from breeding.

Borax is not a very poisonous substance and the feeding of garbage that contains it to hogs, is not likely to be a serious matter, but borax in large quantities does produce gastric disturbances and for this reason a certain amount of care is advisable.

The method for using this substance in the case of stables, is to sprinkle the borax or colemanite in the quantities given above, by means of a flour sifter or other fine sieve, around the outer edges of the pile of horse manure. The manure should then be sprinkled immediately with two or three gallons of water to eight bushels of manure. It is essential, however, to sprinkle a little of the borax on the manure as it is added daily to the pile, instead of waiting until a full pile is obtained, because this will prevent the eggs which the flies lay on fresh manure from hatching. As the fly maggots congregate at the outer edge of the manure pile, most of the borax should be sprinkled there.

It is estimated that it would cost only one cent per horse per day to prevent all breeding of flies in city stables. If calcined colemanite is purchased in large shipments, this cost should be considerably less. At the same time, its value for use in the garden or for sale to farmers will not be lessened.

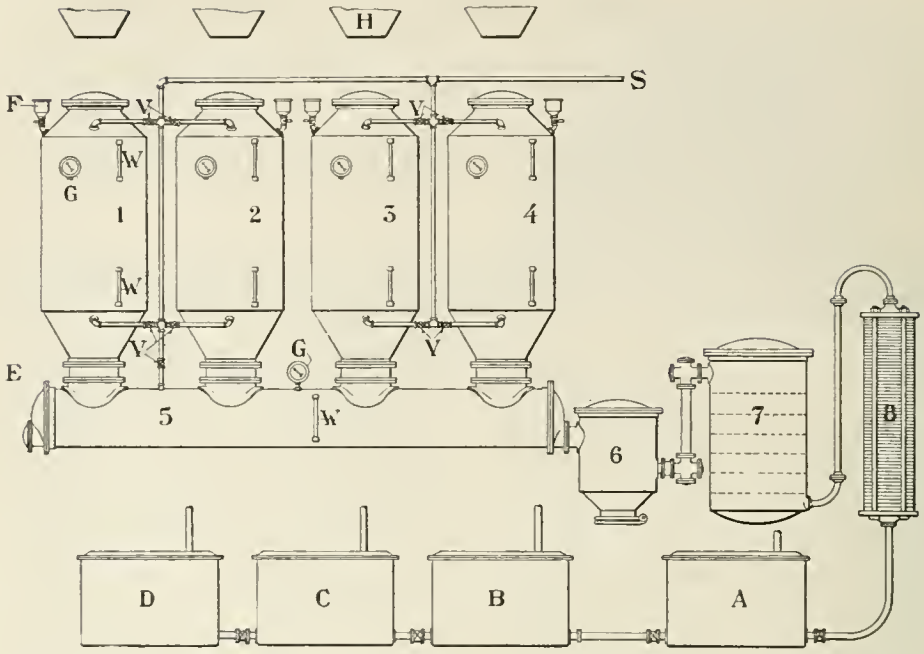
The details of the experiments with borax and other larvacides will be found in U. S. Department of Agriculture Bulletin No. 118.

Garbage Disposal By the Hirsh Chemical System

Sixty thousand tons of garbage were treated by the Hirsch chemical process in the last nine months by the city of Chicago in the temporary plant. They used five wooden tanks without covers. The chemicals completely and promptly deodorized the garbage, rendering decay and odor impossible for all time to come.

The apparatus for treating garbage and other waste material by the Hirsh chemical process, converting them into useful products, in an absolutely odorless manner, consists chiefly in tanks. One tank will completely deodorize and treat its contents within one hour, which includes filling and discharging, as against the old process of rendering for nine hours or more and creating more disagreeable odors at the expense of a great deal of fuel and loss of quality and quantity of fats. A tank of a capacity of five tons will treat fifty tons in ten hours, or 100 tons in twenty-four hours.

For large cities with receiving stations in different parts of the city this system is ideal. The many receiving stations shorten the distance of hauling the garbage, reducing the cost of hauling. But, unless the garbage is completely deodorized and kept deodorized, the nuisance created by the same would be multiplied with the receiving stations. To avoid this a tank



should form the equipment of each receiving station. Samples of garbage treated with the Hirsh chemicals one year and some five years old are as fresh today as on the day they were treated, having only the fresh, aromatic, pleasant odor of the fruit or vegetable constituting the garbage, while meat, fat, bones remain absolutely odorless. This aromatic, pleasant odor of the fresh fruit or vegetables does not spread beyond the tank containing it, and requires a close application of one's nose to notice it. If the Hirsh chemicals are applied to the householder's garbage can or to the wagons carting the garbage, the proverbial ounce of prevention will keep flies at a distance, as they never approach garbage treated in this manner, nor is decay or putrefaction then possible. Such garbage can be hauled thru the streets with as little offense as a load of lumber, iron or apples. Wherever the Hirsh system is introduced, these chemicals will be furnished for wagons and private garbage cans, so it will not then be a question of deodorizing garbage or disposing of bad odors, but only a question of converting the garbage, street sweepings and manure into products more valuable than any ever produced or thought of before. The Hirsh process is the first and only one treating garbage and other waste products chemically for the purpose of deodorization and utilization.

In the drawings annexed H are hoppers, to receive the garbage, which may pass into the tanks 1, 2, 3, 4 if all of them are used for the conversion of garbage. These are designed to hold ten tons and would convert forty tons per hour. Either one of them can be used for conversion alone and independently of the others, all of them forming a system of separating the by-products from the garbage and from each other.

The garbage being placed in tank 1 and treated, the fats and glycerine will collect in tank 2, while dextrin, dextrose, phosphates and some other products remain in tank 1. After conversion and separation, the contents are dropped into tank 5, whence they are forced into tank 6, the inner arrangement in which separates bones and undissolved metal from pulp and liquid. The two last named substances are further separated in tank 7, then forced thru the press 8, which retains all solid matter, while the liquid discharges into tanks A, B, C, D. The press is so arranged that it automatically discharges the pressed cakes of solid matter, while in the tanks A, B, C, D some of the metallic salts are crystallized the tin separated in the metallic state chemically pure without any smelting, leaving in solution dextrin, dextrose, ammonia salts, which are readily separated from each other. The ammonia salts bring the full price they would in the form of fertilizer, while the vegetable portion of what would be fertilizer is converted into dextrin and dextrose, bringing a much higher price.

During the entire operation, the garbage is not exposed to the air. The metal-

lic salts require water for crystallization, dextrin and dextrose require water to keep them in solution. In this way the water is disposed of and utilized and all expense of drying, both for fuel and machinery, is saved. W shows the water glass, indicating the height of liquid in the tank. G is the pressure gage. V are the valves. F is a funnel with pipe connection for introduction of chemicals. S is the steam pipe. Tanks A, B, C, D are connected with each other and can be used jointly or separately. They are provided with pipes for the escape of gases that are utilized.

Where cities do not attempt utilization, but desire only sanitary disposal of garbage, one tank is sufficient, and where, in receiving stations, a tank is added to the equipment, the receiving station may be a conversion station at the same time and save all subsequent handling. Bulky iron waste, like bedsprings, bedsteads, etc., may be thrown into tanks, converted into salts and bring more than double the value they would have as scrap iron, the only handling needed being throwing them into the tanks, which is less than the handling of bulky scrap iron as such.

Plumbing Regulations in New Orleans

The supervisor of plumbing under the Sewage and Water Board of New Orleans, La., in his last annual report describes his duties as follows:

The organization of the plumbing department at the present time consists of the supervisor of plumbing, assistant supervisor of plumbing, first clerk in charge of the records and clerical work of the department, ten plumbing inspectors, whose duties are to inspect the sanitary plumbing from the beginning until the completion and acceptance of the work, and seven plumbing inspectors whose duties consist in making the tie-in or connection direct from the house sewer, with the sewer connection brought up from the sewer in the street to the property line; a receiving and general information clerk, two stenographers, and two men engaged in clerical and inspection work, obtaining data necessary to the serving of notices in connection with the 90-day resolution, complete the force.

Before any plumbing work at all is done it is necessary that a licensed master plumber file a plan showing the character of plumbing that is to be done in the premises in question (signed by the property owner, authorizing the work to be done), said plan showing the size of pipe, kind of traps to be used, and the various methods of venting. Upon examination, should this plan be found to be in conformity with the rules, it is approved by the supervisor of plumbing, or his assistant, and permits granted to the plumber, one to do the work, and the other to permit the premises to be connected to the sewer after said work has been inspected and satisfactorily completed in accordance with the rules.

Four inspections are generally required for every job before it is declared satisfactory in its entirety. The tests consist of a ball test, a house connection or tie-in test, and a water and peppermint test.

The ball test is an inspection and test of the underground terra cotta pipe which runs from the property-line back, receiving the discharge from the plumbing fixtures in the building and conveying same to the public sewer in the street.

The inspector sees that the pipe is laid at a grade of not less than one-quarter of an inch to the foot, and that the joints are properly made, calked and cemented, and that the proper covering is maintained in accordance with the plumbing rules. The line is then tested by sending a wooden ball, one-half inch less in diameter than the diameter of the pipe, thru it, from end to end.

The house connection inspection is made where the public and house sewer are joined together at or near the property line. This inspection consists of seeing that the proper fittings are used, clean-outs brought up, so as to enable the proper cleaning out of the line in the event of stoppage, and the proper concreting of the whole.

The water test is made after the plumbing work inside of the building has been "roughed-in." The stacks are filled with water and allowed to remain in that condition for some hours. The inspector then examines the joints closely, and if they are improperly calked, leaks will appear at these joints. At the time of this inspection it is the duty of the inspector to examine the kind of pipe used, i. e., whether standard or extra heavy (for in some instances only the latter can be used), the depth of hubs, the size of pipe, the proper use of vents, and, in fact, to see that in every particular the work conforms to the rules of the board and is sanitary in every respect. This is the severest test put on the work, for, having passed this test, the only thing necessary to be done is the setting of the fixtures.

The fixtures having been set, the work is then subjected to what is known as the peppermint test. This test consists of pouring into the clean-out a mixture of hot water and oil of peppermint. The fumes that arise from this mixture are so pungent that if the work is not absolutely tight the odor of peppermint will be immediately detected in the premises. The inspector then tries out all the fixtures for the purpose of ascertaining whether

or not they are in good working order. At the time of this inspection all vaults and cesspools must be excavated, cleaned and filled, and the work as a whole must be in a completed condition.

It is only after these tests and inspections have been made that what is known as a final certificate is issued. This certificate is to the effect that the plumbing has been inspected and tested, and found in substantial accord with the plumbing rules and regulations.

Up to the first day of November, 1908, this department not only received all applications for sewer and water connections, but attended to the installation of same. From that date up to May 1, 1913, these applications from the public for sewer and water connections were still received and passed upon by this department, but the installation of the work was not supervised by this department. From that date, however, these applications also have been received in the sewer and water connection departments, and while some conditions necessitate this department at various times being consulted on these applications—and in this respect I particularly refer to the sewer connection application—this branch of the work is almost in its entirety handled by the above respective departments.

There are at present 169 licensed master plumbers doing business in the city of New Orleans, in connection with the plumbing department. In order for a plumber to obtain a master plumber's license he has to be at least twenty-one years of age and pass a satisfactory examination, both practical and technical, as to his ability to do the work. Applicants are provided with application blanks setting forth the name and residence of the applicant, the number of years in the plumbing business, the name of the last employer, and references as to the ability and reliability of said applicant; also the name of the bondsman or bonding company which will sign the required bond; also a promise that said applicant will pay the fees of said board, before he will be permitted to stand the examination.

As to a firm or corporation wishing to do business as such, they have to file with the Sewerage and Water Board a statement showing the composition of said firm; or, if a corporation, a copy of its charter, and shall have at least one member or officer of said firm or corporation qualify as a licensed master plumber.

The examinations are conducted by the supervisor of plumbing and are written, or oral, or both, technical and practical, sufficient to determine an applicant's ability to draw proper plans for plumbing work and show knowledge of the theory and practice of plumbing in general and of the plumbing regulations of the city of New Orleans.

In reference to master plumbers and these examinations, the above gives some idea as to what is necessary, everything in connection therewith being more in detail in the rules of the Sewerage and Water Board governing use of sewerage, water and drainage systems, and plumbing, from which rules this is taken.

The plumbing department has been in operation since October, 1906, at which time it was organized with Mr. J. L. Porter as supervisor, who remained as such until 1908, when he was transferred to the position of director of the water purification plant, and the present incumbent assumed charge of this department.

Previous to the installation of the sewerage system in this city and organizing of the plumbing department there were very few set rules concerning the installation of sanitary plumbing, everything at that time being connected to cesspools or vaults, which were required by law to be cleaned at certain intervals.

The work in general has progressed smoothly, and there has been very little complaint concerning the sanitary plumbing, the stoppage of pipes, etc., and what defects have arisen were such that they were rectified with little trouble or expense.

Illinois Good Roads Law Valid

The Supreme Court of Illinois in the case of Jacob Martens of McLean county, Ill. v. the State Auditor and State Treasurer to restrain them from paying out money for state aid roads has decided in favor of the Tice law, thus attacked, which provides for state aid for road building to counties under certain conditions.

What the Snow Cost

It cost New York City $2,440,000 to clean the streets of snow last winter.

Bridge Specifications of the Illinois State Highway Department

The Illinois State Highway Department has issued standard contract form and general specifications for bridge work, which must be used on all bridge work requiring the approval of the state highway commission or a county superintendent of highways, contracted for of placed under construction after July 12, 1915.

Proposal forms accompany the specifications, one set to be used in letting contract for a single concrete bridge, one for a single steel bridge and one for several concrete bridges to be let in one contract.

FIRE AND WATER

Shingle Roofs Spread the Salem Fire

Massachusetts is still bending a thoughtful brow over the ruins of Salem.

Everybody agrees that the one thing which contributed most to the spread of the fire was shingles. House after house burst into flame when the rain of sparks touched the tinder-like shingle roofs. A dry, weathered shingle makes about the finest kindling known. In a closely populated town, a brisk wind carries flames over shingle roofs as fire sweeps over sunburnt prairie grass.

The Bay State is using the Salem fire to start a strong argument against shingles. It will do the rest of the country no harm to listen.

It is significant that two of the few buildings that were absolutely unaffected and which were in the midst of the Salem fire, subjected to falling sparks and burning embers, were covered with asbestos roofing.

New Water Supply for Greater Winnipeg

THE "Greater Winnipeg Water District" consists of the City of Winnipeg and surrounding municipalities. Appointed by the administration board to have charge of this work are: Mr. S. H. Reynolds, chairman of commissioners; Mr. James H. Fuertes, consulting engineer, and Mr. W. G. Chase, chief engineer.

A fine quality of water from Shoal Lake will be brought to the city of Winnipeg by means of a gravity line ninety-five miles in length.

A concrete aqueduct will carry the water from the intake, which is located on Indian Bay, a branch of Shoal Lake, to a reservoir (250,000,000 gallons capacity), which is to be constructed at Deacon, about ten miles from Winnipeg. The capacity of this portion of the line will be 85,000 000 gallons per day. The total cost of the entire project will be $13,000,000.

From the reservoir a 5-foot steel pipe will be laid to the east side of the Red River crossing, a distance of about eight miles. From this point to the distributing reservoir at McPhillips street will be a 4-foot cast iron pipe; there will be several heavily reinforced depressed 8-foot circular sections at the river crossings along the line, while at the Red River crossing in Winnipeg a 5-foot cast iron pipe will be laid, imbedded in concrete, in a tunnel.

From the intake west, for a distance of eleven miles, a rectangular reinforced concrete section will be used. The size of this section will be approximately 11½ feet by 7¼ feet, and the remainder of the aqueduct will be the various sizes of an arch section of plain concrete. The sizes will vary, according to the different slopes, from 9 feet by 10 feet to 5½ feet by 6 feet; the average slope is 0.69 foot per 1,000 feet, while the heaviest is 1.54 feet per 1,000.

Along the line of the aqueduct there will be Venturi meters, waste weirs and blow-offs.

The aqueduct section of the work will require approximately 3,074,000 cubic yards of excavation, 2,300,000 cubic yards of back-fill, 375 000 cubic yards of concrete and 13,000,000 feet B. M. timber for platforms and drainage.

The intake is situated on Indian Bay, near the mouth of the Falcon river, a stream of brackish water. In order to prevent this water from contaminating the waters of the lake near the intake, the course of this river will be changed by means of a dyke and channel. This will force the Falcon river water into another section of the lake away from the intake.

The dyke will be 7,300 feet long, with a maximum height of about 29 feet; maximum width, 130 feet, and will require approximately 233,000 cubic yards of sand and gravel filling and 17,000 cubic yards of rock rip-rap. The diversion canal will be about 3,500 feet long, with a 30-foot width at bottom, and requiring an excavation of about 40,000 cubic yards of earth.

In order to carry on this undertaking, which is in a very rough and unsettled

country, it is necessary to construct a standard-gage railway for the transportation of materials and supplies, and also a telephone line. This railway will be laid with 60-pound steel, and will require 1,000,000 yards of excavation for embankment, 200,000 yards of ballast and 10,600 gross tons of rail.

The right of way will be from 300 to 500 feet wide, thus giving plenty of room for the aqueduct and the railway, with the contractors' working tracks between.

The district will operate the railway and supply the contractors with all sand, gravel and cement for the aqueduct. The sand and gravel necessary for the construction of the aqueduct will be obtained near the right of way from two pits approximately a quarter of the distance from each end of the work. These pits will be operated by the district and will be equipped each with a steam shovel, dinky locomotives and dump cars. Hopper bins of about 2,000 yards' capacity will be installed in the pits, with the necessary screening apparatus for screening the gravel into the proper sizes necessary for the work.

The aqueduct work will be divided into six contracts, and it is expected that five years will be necessary to complete the aqueduct, the first year of which will be entirely devoted to the construction of the railway.

In 1915 actual work on the construction of the aqueduct will commence and will continue thruout the four following seasons. Five location parties were in the field from October, 1913, to March, 1914, making the necessary surveys for the location of the aqueduct. In March engineering construction parties were put into the field and clearing and grading was commenced on the right of way.

The Northern Construction Company, of Winnipeg, have the contract for the grading of the entire railway line, and expect to have it completed and ready for operation by January 1, 1915.

Comparison of Centrifugal and Reciprocating Pumps

The following comparison of the economies of large reciprocating pumps and centrifugal pumps was made in connection with the design of new pumping units for the Chain of Rocks pumping station of the St. Louis water works. It presents in brief the reasons for the present popularity of the steam turbine and multi-stage centrifugal pump. L. A. Day included it in a recent paper presented to the St. Louis Engineers' Club.

In considering relative values, not only first costs but operative, maintenance and interest charges as well must be taken into account. Progress in the design of centrifugal pumping units has reached a point where serious doubt is created as to the wisdom of invariably installing enormous piston pumping engines, for in installing large pumping engines entailing a considerable expenditure, it seems wise to consider not only the possible life of the machinery, but its probable duration in view of present developments. It is true that the high duty steam pumping engines, with capacities for pumping large quantities of water, are superior to turbine driven centrifugal pumps in economy. However, a careful comparison between the two types of pumping units led us to choose the turbine driven type of pump.

Two 40,000,000-gallon reciprocating pumps for this service would have cost approximately $230,000, or $115,000 each. The duty in foot-pounds of work per thousand pounds of steam of the reciprocating type of pump would have been approximately 150,000,000. Two 40,000,000-gallon turbine driven centrifugal pumps cost $55,000, or $27,500 each, with an average duty of 94,000,000. The average maintenance costs of reciprocating units, according to station records as kept on the Allis-Chalmers 30,000,000-gallon pumps, is $780 each per year. It is safe to assume a maintenance cost not exceeding 2 per cent. of cost of turbine pumps per year, or $550 each per year. The operating charges are considered the same for each type of pump.

In capitalizing the investment the following formula was derived:

$$\frac{A \times W \times H \times P}{D} + F(i+d) + L + M = C;$$

in which

A = Total number of gallons pumped per year.

W = Weight of a gallon of water.

H = Average total head of feet pumped against.

P = Cost of steam per 1,000 pounds (13.4 cents).

D = Average duty in foot-pounds per 1,000 pounds of steam.

F = Total investment.

i = Rate of interest on investment.

d = Rate of depreciation.

L = Yearly cost of operating labor.

M = Yearly cost of miscellaneous expenses of operation.

C = Total cost per year.

Solving for C with both types of pumps we obtained a difference of $13,000 per year in favor of the turbine driven pump, which means that in a little more than four years the centrifugal pumps will have paid for themselves. It is proposed to install a third turbine driven pump of 40,000,000 or 50,000,000-gallon capacity in this station in the next two years, in

order to bring the safe working capacity up to 150,000,000 gallons per day, and if reciprocating pumps were necessary, it would necessitate the erection of an additional building owing to the space they require. Needle ice suspended in the river water during the winter months and sand thruout the year are additional important reasons for installing centrifugal pumps at this station, as this type of pump is admirably adapted to handle water under these conditions with practically no trouble.

Calcium Hypochlorite as a Water Disinfectant

By E. J. Tully, Chemist, State Hygienc Laboratory, University of Wisconsin, Madison, Wis.

In a study of the effects of calcium hypochlorite upon water when used as a disinfectant the author experimented upon the clear public well water supply of Madison, Wis., the waters of Lakes Mendota, Michigan, and Winnebago, with varying degrees of turbidity and pollution. He also tested the amount of hypochlorite which would leave a taste or an odor in the clear city water and in Lake Mendota water, using the testimony of several persons on various samples after various periods had elapsed, 1 to 48 hours after treatment. The summary and the conclusions he draws from these experiments, as given in the *American Journal of Health*, are as follows:

Chemical disinfection offers a means whereby a very satisfactory purification of a water may be accomplished. Comparisons on a cost basis of the methods of chemical disinfection mentioned make it apparent that calcium hypochlorite is the most satisfactory and efficient agent at the present time for water disinfection.

The amount of organic matter in the water practically determines the quantity of calcium hypochlorite that it is necessary to use. As a general rule, practical sterilization may be accomplished by the application of from 0.1 to 1 part per million of available chlorin, but occasionally concentrations of 2 and 3 parts per million of available chlorin are necessary to effect desirable results with rather highly colored and turbid waters.

The removal of B. coli and intestinal organisms is usually more complete than that of the total organisms. Under the conditions of the laboratory experiments, the results of hypochlorite disinfection on typhoid organisms and intestinal bacteria in the various waters were practically identical. It is, therefore, safe to assume that the viability of pathogenic bacteria under working conditions in practical water disinfection is no greater than that of the typhoid organism, or intestinal bacteria as a whole. Consequently, the disinfection effected by calcium hypochlorite relative to the total bacterial removal may be referred directly to pathogenic bacteria with assurance of reasonable accuracy.

The slight odor and taste of chlorin imparted with somewhat more than 0.5 part per million is applied disappears in a short time, leaving the water entirely acceptable from a sanitary standpoint, and, as the hardness is not materially increased by the application of the usual small quantities employed, the treated water is not rendered unsuitable for industrial purposes.

There is no apparent reason for believing that the results are not of general applicability. The reactions involved are particularly free from interference on the part of the mineral constituents of normal waters; and normal variations of temperature have practically no effect on the final results. The efficiency of the process is also entirely independent of the secondary or after growth of harmless resistant organisms.

The calcium hypochlorite process of sterilizing water combines the desirable qualities of economy and efficiency, and affords cities and towns, which are unable financially to build a filtration plant, but are forced for sanitary reasons to adopt some method of purification, a means of insuring a safe water supply. It may be used to advantage in cases of emergency, where either filtered or unfiltered supplies have become infected and where it is difficult to cease using such supplies. Where mechanical filtration is not sufficient to render a water safe, treatment with calcium hypochlorite offers an excellent method of sterilization and is especially applicable in such cases.

Regulating Growth of Organic Matter in Reservoirs

In a paper before the Franklin Institute, Prof. W. P. Mason gives some suggestions as to the care of reservoirs with reference to preventing the growth of low forms of plant and animal life and improving water in which such growths have been permitted, which are abstracted as follows:

When meadow lands are flooded, the extraction of food for plankton growth must of necessity take place, and we are forced to choose between stripping the proposed bottom or else depending upon the employment of some means of killing or removing the organisms that are likely to develop.

As to what could be done to rid a water of the odors due to algal and other growths, the outlook was not very hope-

ful previous to the appearance of the "copper sulphate process" proposed by Moore and Kellernan in 1904 (Bulletins 64 and 76, U. S. Bureau of Plant Industry).

The method of applying this chemical is simple enough, and its use is very efficacious. Bought in bulk, it can be had at about 5 cents per pound, and its distribution is readily secured by filling it into perforated buckets, or even bags, and towing the same by rowboat or launch over the reservoir surface.

It must be remembered that it is not added to the water continually, but is used only at stated and widely-separated intervals, namely, at those times when the "crop" of minute organisms has become so well grown as to produce objectionable effect upon the water.

Perhaps one reason why the "coppering" of reservoirs has led to so much criticism is because of the dead fish that are to be seen after the chemical has been applied. When considering this effect upon fish life, one should bear in mind that the "dose" has of necessity to be applied uniformly over the surface of the water, and each acre of such surface presumably receives the same amount, irrespective of the depth of water that the acre covers. As a result, the shallow parts of the lake receive temporarily a greater quantity of the sulphate, per cubic foot of water, than do those which are deeper; again, the entire quantity of chemical intended for the whole body of the lake is delivered to a few inches of its surface layer; therefore, until diffusion has taken place, fish which chance to swim into such water receive a very concentrated d e and are likely to be affected by it. Distribution is complete by the time the water reaches the public mains, and, moreover, the minute dose used has been more or less completely disposed of thru its action upon the organisms for whose destruction it has been employed.

In a paper before the section on hygiene of the eighth International Congress of Applied Chemistry, 1912, Kellernan presented the following data:

QUANTITY OF COPPER SULPHATE REQUIRED TO KILL VARIOUS FORMS OF ODOR-PRODUCING ORGANISMS.

Copper Sulphate Required, Expressed as Parts, per Million Parts of Water—	
Anabæna	.09
Asterionella	.1
Beggiatoa	5.
Chara	.2 to 5.
Cladophora	1.
Cladothrix	.2
Clathrocystis	.1
Cœlosphærium	.3
Conferva	.4 to 2.
Euglena	1.
Fragilaria	.25
Hydrodictyon	.1
Kirchneriella	5. to 10.
Leptomitus	.4
Microspora	.4
Navicula	.07
Oscillatoria	.1 to .4
Peridinium	2.
Scenedesmus	5. to 10.
Spirogyra	.05 to .3
Ulothrix	.2
Uroglena	.05
Volvox	.25
Zygnema	.7

He adds a list of twelve genera of algæ that in his experience are causing trouble in reservoirs and ponds:

NUMBER OF OBSERVED CASES.	
Anabæna	27
Asterionella	9
Beggiatoa	20
Chara	26
Cladophora	17
Clathrocystis	23
Conferva	56
Crenothrix	13
Fragilaria	19
Spirogyra	43
Navicula	21
Oscillatoria	49

Jackson claims that blue-green algæ will die if the water be "coppered" one part to five million. His dose for Mellosira or Synedra is one to two million, and he claims that the former gives no odor of growth, but only that of decay. He finds that coppering runs out certain forms of organisms and substitutes others by a sort of selective action, but those thus suhstituted are not likely to be odor producers; and he further notes that, while "hottom" or decomposition odors are easily shaken out by aeration, "top" odors, viz., those of growth, have to be removed hy filtering out the organism, or killing them by copper sulphate, or both. In his opinion, filtration of either type is effective for removal of odors of growth, hut he believes that aeration would be worse than useless for living plankton, for the reason that the agitation would tend to mechanically release the oil causing the taste, which oil is not very easily oxidized.

Naturally the cost of treatment with sulphate of copper will depend in part upon the amount of the chemical that is to he used, which, in turn, is determined by the kind of organism that it is intended to kill; but it may be said that a mixed growth of Mellosira and Asterionella was removed from the Troy reservoir at an expenditure of 14.9 cents per million parts of water treated, labor included. The dose was one part of copper sulphate to 3,500,000 parts of water by weight.

In the article by Kellernan above quoted there are figures given indicating the safe limit for treating water with copper sulphate when certain fish are to be protected.

Copper Sulphate, Expressed as Parts, per Million Parts of Water—

Black bass	2.1
Carp	.3
Catfish	.4
Goldfish	.5
Perch	.75
Pickerel	.4
Suckers	.3
Sunfish	1.2
Trout	.14

It must be noted that these figures assume a thorough mixing of the sulphate solution with the whole body of water. They would not hold for the unequal distribution and resulting local concentrations already mentioned.

In some reservoirs which have been formed by the extensive flooding of swamp bottoms there may develop objectionable growths of Crenothrix, a general term denoting an aquatic plant which at times gives much trouble because of its tendency to develop in the street mains and clog the pipes. It is often discovered quite unexpectedly, being dislodged by the current attending hydrant flushing or by the draft caused by fire engines. Dead ends are spots likely to harbor it, and its long, rusty filaments have been mistaken for horse manure.

There are three types of the growth, each possessing the peculiarity of precipitating from the water in which it grows its own particular metallic hydroxide. By far the commonest of the three is Crenothrix Kuhniana, which demands iron for its development and which deposits large amounts of iron hydroxide as the result of its growth. The iron required for growth must be in solution, and the quantity demanded would seem to be about 0.3 part of Fe per million.

In order that the iron may be in solution, we naturally would expect the dissolved oxygen to be low and the quantity of reducing agents, such as organic materials, to be high, and those are the conditions that we find in practice to be favorable to the development of the plant.

It is likely to be encountered in waters from swampy, peaty sources, where dissolved oxygen is scanty and where the necessary iron in solution may be had. Driven wells in such localities frequently furnish it. Darkness favors its growth, and its development in city water mains is often excessive, resulting in a material reduction of the carrying capacity of the pipes. The writer has some doubt about the "manganese" variety of Crenothrix being as rare as some think it is, he having found large quantities of manganese in a heavy Wisconsin growth. Beythien and others have, moreover, noted that the presence of manganese in water directly favors the growth of the ordinary form of Crenothrix.

Beyond the mechanical stopping of street pipes, Crenothrix is exceedingly objectionable to the laundry interests of the community, for the reason that its rusty filaments cause "iron stains" to appear upon white linen.

Removal of the iron by oxidation and filtration is the best guard against troubles due to Crenothrix.

It must not be sweepingly assumed that all the "plankton" life is to be rated as uniformly objectionable; quite the contrary, as a reasonable degree of it acts as a distinct help in maintaining the safety of natural waters. Thus we find "bacteria eaters," such as many kinds of ciliated infusoria, rotifers, daphnia and the like, feeding upon minute germ life, and doing so to our great advantage.

To quote from a translation by Kuichling: "The question is, what becomes of the great quantities of offal and excreta, the many remnants of decaying plants, the refuse of communities, and the finely-divided factory wastes of every description, which find their way into our streams, even under normal conditions, if a large portion thereof is not consumed by the aquatic detritus-eaters and the omnivorous fauna before settling to the bottom?"

With a view to avoiding the troubles arising from the undue growth of taste and odor-producing organisms, the stripping of reservoir sites and the removal of a portion of the upper soil has been advocated and carried into practice. This, of course, entails very great expense when the surface to be stripped is at all extensive, as in the instance of stripping the Nashua reservoir supplying Boston. At Columbus, O., such work cost $159 per acre.

In their report upon the probable cost of stripping the surface soil from the Ashokan reservoir site, which is to hold the water supply for New York City, Messrs. Hazen and Fuller stated it would possibly reach the great figure of $5,000,000.

In view of the expense of such treatment for large reservoirs, the question is pertinent, "Does it pay?"

At Holyoke, Mass., the annual water report for 1908 says: "Great care had been taken in cleaning and stripping the reservoir by removing all vegetable and organic matter, thus lessening to a minimum the food supply for supporting living organisms in the water. The thoro cleaning of the reservoir has not been wholly successful, as an aquatic plant

known as 'Chara' has grown and flourished in the reservoir all summer and imparted to the water a taste and odor that made it unfit for drinking or even for cooking purposes."

Mr. J. M. Diven ("American Water Works Association," 1908) has had interesting and contrasting experiences with both stripped and unstripped reservoirs:

"The Elmira reservoir was as thoroly stripped as possible; great care was taken to keep out the first washing from the drainage area and the muddy flood waters. There was little or no marsh land on the drainage area, the catchment area being seemingly ideal. The reservoir was clean and clear; on the sides the slopes were abrupt, and there was very little shallow water.

"At Charleston, S. C., the drainage area was largely swamp, and there was much decayed vegetable matter on all of the area drained, the water being decidedly peaty. The reservoir covered a large surface, was shallow, and absolutely unstripped or even cleared. Much of the land flooded was composed of black muck or decayed vegetable matter.

"In the first case (Elmira) the conditions were at the first satisfactory and the water good for several years. But trouble from algal growth came in time and has steadily grown worse, in spite of strenuous efforts to remedy the condition.

"The second case (Charleston) was troublesome and unsatisfactory from the first, but has somewhat improved and promises to continue to improve."

The writer's experience leads him to advocate the expenditure of comparatively little money in the preparation of sites for large storage reservoirs, for the reason that, altho thoro stripping will likely give immunity from algal growths for some years, yet freedom from the occurrence of taste and odor in the stored water may not last for long. Sooner or later there will be carried into even the most carefully cleaned reservoir enough food material to sustain a plankton growth of a density governed by the local conditions. Broadly speaking, an "old bottom" is better than a new one, because it is likely to contain less plant food; but the rule has many exceptions.

Even natural lakes are frequently seen "in bloom"—that is, loaded with minute life—and they so remain for a period, during which their waters are not acceptable for domestic use. The character of the tributaries must be considered as well as the nature of the bottom of a proposed reservoir, for it is manifestly loss of money to improve the latter if the former can quickly replace much of what has been taken away.

For the sake of general appearances, if for no other reason, trees, shrubs and bushes should be removed. Dead, standing timber and fallen logs are most unsightly and are very likely to produce complaint from the visiting public. In other words, the reservoir site should be cleared and grubbed, with, of course, entire removal of every vestige of human habitation; but beyond that it scarcely pays to go. The portion of the flooded land lying between high-water and low-water marks should receive especial attention, for the reason that during the periods of its exposure it is capable, if uncared for, of presenting an unpleasant appearance and provoking adverse criticism, with the further objection that heavy weed growth may develop if it be long uncovered, which growth will contribute toward the production of taste and smell when the water again covers it.

In an instance where it was proposed to restore a dam that had been out of repair for over fifty years the writer advocated the cutting off of the standing dead timber at the existing water level before closing the breach, in order to insure a better looking sheet of water when the reservoir filled. This was for appearances only, as all extractive matter had been leached out of the old vegetation long before.

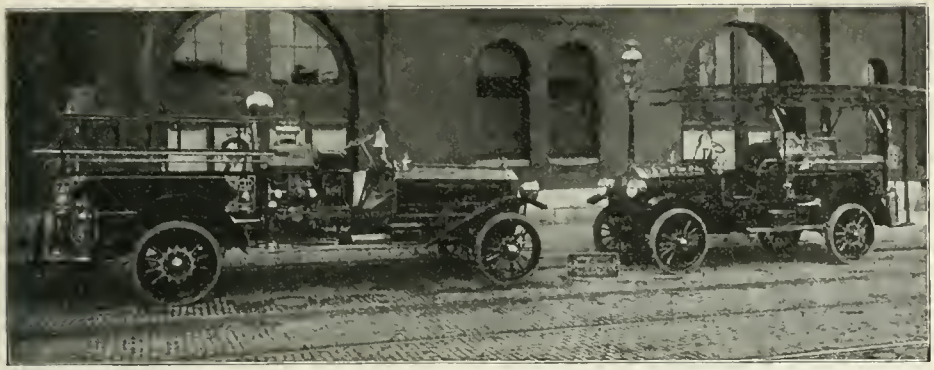
Aeration, filtration and the judicious occasional use of copper sulphate constitute the processes at our disposal for combating the annoyance arising from algal growths, and their use will give greater satisfaction than the expensive stripping of reservoir bottoms, a treatment which was so frequently advocated in the past.

Cost of Maintenance of Horse and Motor Fire Apparatus

The average cost of operating and maintaining motor and horse-drawn fire apparatus is very nearly as shown in the following statements, as the summary of careful study of results in cities in all parts of the country made by the engineers of the Robinson Fire Apparatus Manufacturing Co., prominent makers of motor apparatus in St. Louis, Mo.:

The pumping engine is the most important piece of apparatus in any department, for which the following figures of maintenance are correct:

Expense of pumping engine for one year—	
632 gal. gasoline at 18c	$ 112.96
60 gal. of oil at 40c	24.00
15 gal. kerosene at 9c	1.35
10 lb. cup grease at 15c	1.50
General repairs	20.00
Driver's salary, 12 mo. at $95	1,140.00
Total cost of maintenance of auto	$1,299.81



PEORIA, ILLINOIS, *auto fire equipment. Robinson combination engine and hose; combination chemical and hose.*

Alarms answered, 136.
Distance traveled, 632 miles.
Pumped at fires, 97 hours.
Pumped at drills, 12 hours.

Cost of maintaining one third-size steamer for the same period of time is as follows—

Engineer's salary, one year	$1,200.00
Driver's salary	1,020.00
Feed for two horses, one year	360.00
Horseshoeing	48.00
Fuel for heater	324.00
Coal	30.00
Oil	2.00
Total cost maintaining steamer	$2,984.00

In addition there is also the cost of mantaining hose wagon, which is as follows—

Driver's salary, one year	$1,020.00
Feed for team	360.00
Horseshoeing	48.00
Total cost maintaining hose wagon	$1,428.00

It is seen, therefore, that the cost of maintaining a third-size steamer for one year is $2,984.00 and the hose wagon $1,428.00, which makes a total of $4,412.00 for the steamer and wagon, as against $1,299.91 for the auto engine combination complete, which is a saving per annum in favor of the auto of $3,112.19.

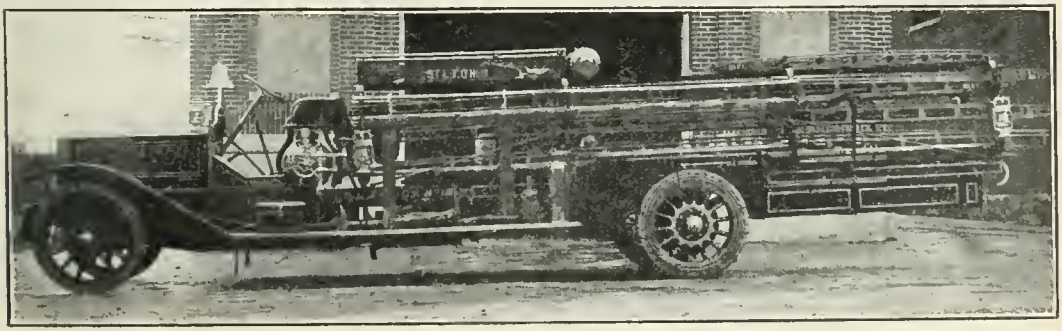
The auto engine will cover on an average four times the territory of a horse-drawn apparatus and will travel in a year's time four times as many miles in answering alarms. Depreciation or the interest on the investment will just about balance and so are not included.

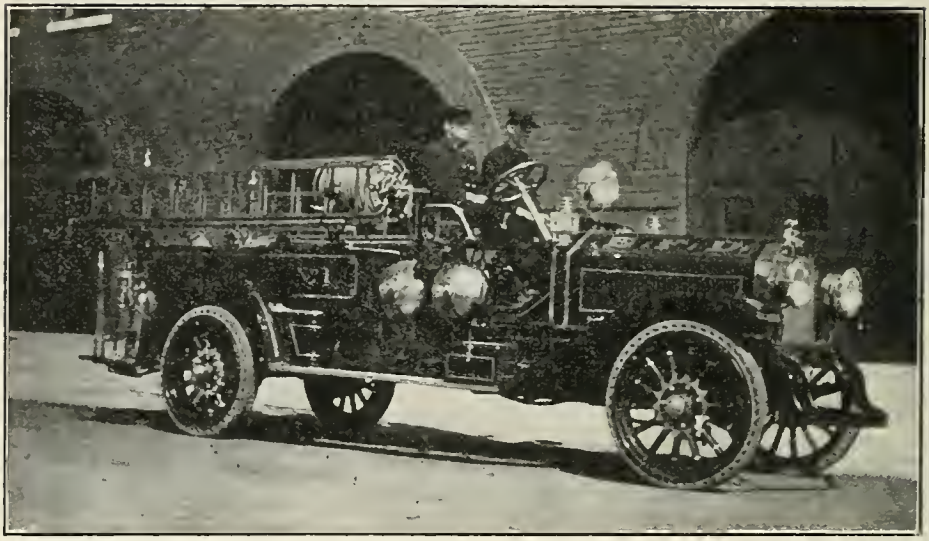
The engine doing the work as above stated will last twenty years and horse-drawn apparatus will last about the same length of time, but owing to having to purchase and train new horses the proportionate maintenance on the horse-drawn apparatus would exceed that of the motor apparatus.

Another point to be considered is the fact that in case of several alarms coming in in one day the horse-drawn apparatus, after it has answered one or two alarms, is unfit for any further duty, owing to the fact that the horses are exhausted, while with motor apparatus it will go to the last fire just as quick as to the first.

Another important item is the fact that in the steam pumping engine it takes from

ST. LOUIS *city service fire truck. Robinson hook and ladder auto truck.*





ROBINSON *motor driven combination chemical and hose wagon for use at Enid, Oklahoma.*

five to ten minutes to get up sufficient steam to do effective work and in case of a fire right at the engine house the firemen must sit still and wait until the boiler gets hot, while with the auto engine it is ready to furnish water the minute the alarm comes in. The chief expense of auto engine was formerly that of tires, owing to the fact that all pneumatic tires were used. For the heavy apparatus first class builders have now adopted cushion tires, of which there are several different types, and these tires are usually guaranteed by the tire manufacturer for a period of from one to three years, practically eliminating the tire expense.

The great saving in motor apparatus is possible, owing to the fact that practically all pumping engines carry their own hose and many of them their own chemical tanks, while with horse-drawn apparatus a hose wagon must always be maintained in addition to the steam pumping engine. This not only necessitates the two pieces of apparatus, but makes larger buildings necessary and in cities where real estate is valuable this is quite an item within itself.

General repairs on motor apparatus from records made by chiefs using Robinson cars all over the country show an average expense slightly less than $20.00 per annum. This amount is, of course, decreased or increased, depending on the care the apparatus is given, but $20.00 will be the average amount expended on apparatus built by the best manufacturers.

Municipal Ownership in Belfast, Ireland

The total revenue of the electric supply undertaking for the fiscal year ended March 31, 1913, was $394,595, as compared with $353,167 the preceding year, an increase of $41,428. The total revenue from electric light and power supply was $276,320; from tramway supply, $116,246, and from other sources, $2,029. The total cost of the undertaking amounted to $227,526 in 1912-13, an increase of $29,506 over the preceding year, leaving gross profits, before providing for interest and sinking fund, of $170,069 in 1912-13 and $155,147 in 1911-12. The total capital employed at the end of the fiscal year 1913 was $2,419,010, the percentage of gross profit to average capital employed being 7.03.

The total number of units sold in 1912-13 was 16,738,143, as follows: Private supply, 6,931,854; public supply, 72,869; traction supply, 9,733,420. In 1911-12 there were sold 15,021,964 units. The total capacity of the plant at the end of the fiscal year was 10,300 kilowatts.

Electric current is supplied for lighting purposes at a flat rate of 3½d. (7 cents) per unit, and for lighting private residences at a flat rate of 3d. (6 cents) per unit. There is, however, an alternative rate on the maximum demand system. For heating and power purposes the rate is graded on the maximum demand system from 2¼d. to 1¼d. (4½ to 2½ cents) per unit, according to the quantity used. The average price per unit obtained in the fiscal year ended March 31, 1913, was 2.18d. (5.62 cents) for lighting, 1.224d. (2.448 cents) for power, and 0.589d. (1.178 cents) for tramway supply.

Lighting

Tungsten Lamps of High Efficiency

By Irving Langmuir and J. A. Orange, before the A. I. E. E.

Radical improvements in the efficiency of tungsten lamps can be obtained by preventing evaporation of the filament or by preventing blackening of the bulb. By the introduction of considerable pressures of such gases as nitrogen or mercury vapor into the lamp the blackening can be practically avoided and the evaporation of the filament reduced very considerably.

By making use of these principles we have been able to construct practical tungsten lamps which, starting at an efficiency of about 0.40 watt per candle, have run over two thousand hours, the average efficiency during life being better than 0.5 watt per candle. It should be pointed out at the outset, however, that such a degree of improvement as this has been reached only in lamps taking large currents.

The early experiments with lamps containing nitrogen at atmospheric pressure were made with ordinary single loop filaments of 0.005 and 0.010 inch diameter placed in long heater lamp bulbs. These lamps were set up on life test at such a voltage that the temperature of the filament was 2577 deg. C.

In order to compare these with ordinary lamps, similar lamps with evacuated bulbs were set up on life test with the filaments at the same temperature.

The nitrogen-filled lamps with the filaments 0.005 inch diameter gave an efficiency of 0.65 watt per candle and had a life of about 90 hours, whereas those with the larger filaments (0.010 inch diameter) gave an efficiency of 0.56 watt per candle and a life of about 300 hours. The bulbs opposite the filaments remained clear, altho a slight brown deposit of tungsten nitride collected in the upper part of the bulbs. The candle-power of these lamps remained above 80 per cent. during their entire life, failure being due in every case to breakage of the filament after this had decreased considerably in diameter.

The vacuum lamps, on the other hand, gave an efficiency of 0.41 watt per candle, but the bulbs blackened rapidly, the candle-power falling to 80 per cent. in about 40 minutes. Since the filaments of the vacuum lamps burnt out after 2 to 5 hours, whereas those of the nitrogen lamps lasted 50 to 100 times as long, it is evident that the rate of evaporation of the tungsten is materially reduced by the presence of the nitrogen.

These results indicated clearly the desirability of using a filament of large diameter. The larger filaments gave not only a better efficiency at any definite temperature, but also a much longer life. Thus doubling the diameter increased the efficiency form 0.65 to 0.56 and increased the life from 90 to 300 hours. The improvement in the efficiency, as was pointed out in the previous article, is due to the relatively greater heat loss by convection from small wires. The life of the filament is determined largely by the loss of tungsten from the filament by evaporation and has been found to be dependent on the relative decrease in diameter caused by this evaporation. If the rate of evaporation per unit area from large and small wires were the same, the lives of various filaments run at a given temperature would be roughly proportional to their diameters. However, as the evaporation of tungsten in nitrogen is largely a diffusion process, it probably obeys laws similar to those of conduction or convection of heat from a wire; that is, for wires of small diameter, the actual amount of tungsten evaporated would be nearly independent of the size of the wire. The rate of evaporation per unit area would thus be approximately inversely proportional to the diameter. The relative lives of very small wires in nitrogen are therefore nearly proportional to the squares of their diameters.

These results were decidedly encouraging, for both efficiency and the life of the lamps can be improved by increasing the diameter of the filament.

It is, however, not desirable to use filament of very large diameter if similar results can be obtained with smaller ones. The current taken by a filament increases

approximately with the three-halves power of the diameter. Thus, for wires of the sizes used in the preceding experiments, the currents needed to maintain a temperature of 2577 deg. C. were approximately:

Diameter		Current
Inches	mm.	Amp.
0.005	0.127	3.0
0.010	0.254	8.5
0.020	0.508	24.0

Unless very low voltages are used, the power consumed with the larger wires is so great that only very high candle-power lamps can be made.

Therefore it was of vital importance to increase the effective diameter of the filament without decreasing its resistance, and various methods of doing this were tried.

This result may, for example, be obtained by using a tubular filament. The method which has thus far proved most satisfactory, however, is to wind the filament into the form of a tightly coiled helix.

The use of a helically wound filament presents several very interesting features. The life of ordinary single loop filaments is limited by the irregularities in diameter which develop after a considerable amount of tungsten has evaporated. These irregularities, after they first appear, tend to magnify themselves very rapidly, on account of the tendency for the current to overheat any spot which becomes thinner than the rest of the filament. The overheating increases the rate of evaporation and rapidly causes failure.

In the gas-filled lamps, however, when helically wound filaments are employed, a new factor is introduced which entirely counteracts this tendency to overheat in spots. In designing the filaments of these lamps, it is evidently desirable to wind the filament on as large a mandrel as possible, in order to obtain the advantage of the large diameter. Since tungsten is a relatively soft material at the operating temperature of these lamps, too large a mandrel should not be used, as otherwise the weight of the filament pulls out the helix very materially in a few hours, and the heat lost by convection may thus become greater than if a helix of smaller diameter had been used. In actual practice the filament is designed so that the amount of sagging during life will be perceptible, but not enough to cause too great a change in the characteristics of the lamp.

If, during the life of the lamp, any part of the filament should, for any reason, evaporate more rapidly than the rest, so that the filament becomes somewhat thinner, this portion will have less mechanical strength than the rest and will therefore sag more rapidly. The helix will therefore open out wherever the filament becomes thin or becomes overheated. This will cause increased heat loss both by convection and radiation, and thus prevent local overheating or spotting.

The use of helically wound filaments increases the life of the lamp many times beyond the life that would be obtained with a straight filament running at the same efficiency. This is especially true of the smaller sizes of wire.

Besides the helically wound filament, various other forms have been tried, and, for special purposes, many of these have decided advantages.

In the ordinary evacuated lamp, the choice of a suitable bulb is a comparatively simple matter. It must be of convenient size and shape, and provide sufficient room for the proper mounting of the filament. Furthermore, it must have as large an inside surface as possible, so that the density of the deposit of evaporated tungsten will be small. It is also desirable to have the bulb at a sufficient distance from the filament and so related to the power input into the lamp that the bulb does not become overheated. This latter is not only desirable from the view point of safety (in case of lamps for domestic service), but because it is difficult to remove water vapor so thoroly from the bulbs that the life of the lamps will not be greatly shortened by an overheating of the glass.

In the nitrogen-filled lamps, however, several other factors must be considered, especially in the lamps of high candle-power.

In ordinary lamps about 20 per cent. of the energy radiated from the filament is intercepted by the glass and causes heating of the bulb. In the nitrogen lamp, beside this radiated heat, there is an additional amount of heat carried to the bulb by convection—an amount varying with the type of lamp and ranging from 6 to 40 per cent. of the total input. The convection currents carrying this relatively large amount of heat travel vertically upwards from the filament and strike a relatively small area of the bulb, which thus tends to become greatly overheated. Unless special precautions are taken, this overheating will cause the liberation of enough water vapor to cause attack of the filament and consequent blackening of the bulb. It is thus highly desirable, in ordinary cases, if small bulbs are to be used, that the filament should be placed in the lower part of the bulb. This has the further advantage that it allows sufficient surface of glass in the upper part for the deposition of the tungsten nitride.

For a similar reason it is generally desirable, altho not necessary, to make the bulbs with their height considerably greater than their horizontal diameter.

By special design of the bulb, satisfac-

tory lamps have been made with bulbs of only one-half to one-third as large a volume as that of evacuated lamps of the same wattage. This means that for bulbs of the same volume the nitrogen lamps give roughly from five to ten times the candle-power of evacuated lamps. The bulbs of such lamps naturally run much hotter than those of ordinary lamps. The upper parts of the bulbs are often 100 to 200 deg. cent. or more, while the lower parts are sometimes much cooler than this, although closer to the filament.

Several special varieties of heat-resistance glass have been used for the bulbs, making considerably smaller ones possible, as well as rendering it easier to get rid of water vapor. Transparent quartz bulbs have been tried, but do not seem to have sufficient advantage over some of the special glasses to offset their present high cost.

For some of the larger size lamps which take heavy currents (20-30 amperes) it has been necessary to devise special types of lead-in wires. Platinum has been discarded entirely, even in the smaller sizes. Several types of heavy current leads have been successfully used. Most depend on the use of special alloys which have the same co-efficient of expansion as the glass. Bulbs of special glasses into which tungsten or molybdenum wire can be sealed directly, have also been used.

In many of the larger lamps the lead-in wires pass thru the lower end of the lamp. In this case they can be made short. In others, however, the leads are brought in from the top. This requires more care in the construction of the seal if it is exposed to the heat from the convection currents. Screens are sometimes used to protect the seal or other glass parts from direct contact with the convection currents, and to reduce convection.

We have seen that at constant temperature, both the efficiency and the life improve as the diameter of the wire is increased. With very large wires (0.020 to 0.040 inch diameter) which take 20-60 amperes, the efficiency may reach 0.40 watt per candle and probably even better, and yet give a life over a thousand hours. It probably be worth while, in some cases, to use nitrogen in low-current lamps, even if an efficiency no better than that of vacuum lamps is obtained, in order to gain certain other advantages of the nitrogen-filled lamps, such as better color of the light, higher intrinsic brilliancy, etc.

The principal limitation of the new type is therefore that of current. There is no practical upper limit to the current, provided the voltage is not lowered to keep constant power consumption. (As an example, a lamp taking 60 amperes and giving 6,600 candle-power at 0.40 watt per candle has been successfully run.) With increasing current, larger and larger filaments are used and the efficiency that may be practically reached increases towards the limit of 0.20 watt per candle, which is fixed by the melting-point of tungsten. Unless special expedients are employed, the cooling effect of the leads lowers the efficiency of the lamps by an amount that is inversely proportional to the voltage and nearly independent of the size of the wire or the current strength.

With voltages of 20 volts or more, this effect is not serious, but for voltages as low or lower than 10 volts, it may become very important.

For the particular type of nitrogen-filled lamp which has at present been furthest developed, it may be said that a life of over 1,500 hours is obtained at efficiencies better than 0.50 watt per candle only in large units taking over ten amperes. Lamps running at 0.6 to 0.7 watt per candle have been made in units taking at least 5 amperes.

No serious difficulty has been met in making high-voltage lamps. In nitrogen at atmospheric pressure there is no tendency toward arcing, even at 250 volts. Many lamps taking 6 or 7 amperes at 110 volts have been made up and run at 0.6 to 0.7 watt per candle, with a life of over 1,000 hours.

A number of special types of nitrogen-filled lamps have been made and tested. Among these the most interesting, for the present, are perhaps the following:

1. Large Units of Very High Efficiency (0.4 to 0.5 watt per candle with a life of 1,500 hours or more). These take currents of 20 to 30 amperes and (except in units over 4,000 candle-power) are therefore best run from a.c. circuits by means of small transformers or auto-transformers giving a voltage depending on the size of unit desired. Thus, with 30 volts and 25 amperes, the power would be 750 watts and this, in a lamp of say 0.45 watt per candle, would give 1,670 candle-power. Higher or lower candle-power may be obtained by using other voltages. Typical lamps of this kind are shown in Figs. 1 and 2.

2. Small Units of Low Voltage. These take currents of ten amperes or less and voltages as low as four or five volts. The efficiencies with 1,000-hour life range from 0.6 to 1.0, or even 1.25 watts per candle, according to the current used.

These lamps are adapted for series street lighting on 6.6-ampere circuits (at 0.6 to 0.7 watt per candle), for stereopticon lamps, automobile headlights and in general wherever a source of high intrinsic brilliancy, steadiness and white color is needed.

3. Lamps to Run on Standard Lighting Circuits (110 volts). Large units of this

type (several thousand candle-power) have efficiencies of 0.5 watt per candle or better. With smaller units the efficiency is ordinarily not so high.

A lamp of this type is illustrated in Fig. 3. The leads may be brought in from the top, in which case they are preferably made longer so that the filament remains in the lower part of the bulb.

Besides its high efficiency, the features of the new lamps which may, at least for certain purposes, prove of advantage, are:

1. Color of the Light. The temperature of the filament being 400 to 600 deg. higher than that of ordinary lamps, causes the light to be of a very much whiter color, so that it comes closer to daylight than any other form of artificial illuminant except the d.c. arc and the special Moore tube containing carbon dioxide. The color is almost exactly like that which can be had for a few minutes by running an ordinary tungsten lamp at double its rated voltage.

Work is at present under way to develop special color screens which, when used with this light, will give a true daylight color (corresponding to the radiation from a black body at 5,000 deg. C.). From measurements with the spectrophotometer, it can be calculated that the screens which will accomplish this purpose will absorb from 65 to 75 per cent. of the light, so that the net efficiency will be about 2.0 watts per candle for a pure daylight color. At present, to accomplish this purpose with ordinary tungsten lamps, screens must be used which absorb so much light that the net efficiency is between 10 and 12 watts per candle.

2. High Intrinsic Brilliancy of the Filament. At the operating temperature of the nitrogen-filled lamps the intrinsic brilliancy of the filament is about 1,200 candle-power per sq. cm. In ordinary tungsten lamps, on the other hand, running at about 1.25 watts per candle, the filaments have a brilliancy of only about 150 candle-power per sq. cm. The brilliancy of the filament of the nitrogen lamp is thus about eight times that of the ordinary lamp.

This feature, combined with the high degree of concentration preferably used, renders these lamps particularly useful for projection work, such as for headlights or for stereopticons.

3. Constancy of Characteristics During Life. It is often possible to so design these lamps that their ampere, volt, and candle-power characteristics remain practically fixed during the greater part of their life. In any case, however, since there is no deposit on the bulb to cut off the light, the candle-power practically never falls below 75 per cent. (this decrease sometimes being due to sagging). The lamp usually fails by the breakage of the filament with the candle-power well above 80 per cent. of its original value.

Light Distribution of Nitrogen-Filled Lamps. In the preceding paper, wherever efficiencies of lamps have been given, they are expressed in watts per horizontal (international) candle measured in the direction perpendicular to the plane of the filament if this is in the form of a single loop.

Careful measurements have shown that with helically wound filaments the distribution of light in a horizontal plane is almost perfectly uniform, therefore the efficiencies that have been given may be considered to represent also watts per mean horizontal candle.

The spherical candle-powers of many of the lamps have been measured. The ratio of mean spherical to maximum horizontal (practically mean horizontal also) candle-power has been found to average about 84 per cent. for the lamps made with single loops of helically wound wire.

It is possible to design the filaments of nitrogen-filled lamps so as to give a maximum of candle-power in a given direction. This is being done in stereopticon lamps.

Strong Incandescent Lamps for Ornamental Street Lighting

Novalux ornamental units designed for ornamental street lighting, are made for both series and multiple operation and will accommodate the 400 and 600-c. p. 6.6-amp. and the 600 and 1000-c. p. 20-amp. sizes of the series Mazda, and the 400, 500, 750 and 1000-watt multiple Mazda lamps.

They are made in two general styles, the only difference being in the glassware equipment. The glassware on one style consists of a medium alabaster globe, which is so shaped that it is completely filled with light and permits a certain amount of light to pass upward and illuminate the building fronts. There is a small reflector placed at the top and inside of the globe. The function of this reflector is to direct downward and make useful the light that would otherwise be lost in the bottom of the ventilator surmounting the globe. The other style of unit has a two-piece globe. The bottom part is made of crystal rough-inside glass, while the top is made of pyro glass. No reflector is used, as the pyro top is made of dense glass having the inside glazed, thereby reflecting downward some of the light, altho enough filters thru to illuminate properly the building fronts.

These new units are highly ornamental and the casings, which are designed to form the capital of the pole, are made in four different styles, from which a selection can be made to harmonize with the pole design.

NOVALUX *ornamental lamp and post designed together to produce the most artistic appearance day and night.*

Ventilation has been given very careful attention. Air enters thru small holes in the globe seat and leaves thru concealed openings in the spun-copper ventilator at the top of the globe in one form, and in the other it leaves thru the space provided between the top and bottom globe. The socket used in these fixtures is made in skeleton form, which permits a circulation of air to all parts.

As the effieiency of the 20-amp. Mazda series lamps is much higher than that of the 6.6-amp. lamps, the Novalux ornamental series unit contains an internal individual compensater mounted inside of the ornamental casing. These compensators operate the 20-amp. lamps on 6.6 or 7.5-ampere circuits. This saves about 50 per cent. of the energy required to operate the lamps and permits them to be connected in standard existing circuits, thereby allowing the extension of the lighting system without additional station equipment. The compensator also reduces the effect of destructive current surges that may be set up by arcing or permanent grounds.

Gas Cluster Lighting

The improvements in the manufacture of gas, resulting in reduction in cost and the invention of incandescent mantels and like intensifiers of gas light, have resulted in advances in gas street lighting which are quite as remarkable in their way as are the recent improvements in electric lighting. A recent development in the gas lighting field is cluster street lighting with the "gas white way" installations, one of which is shown in the accompanying photograph.

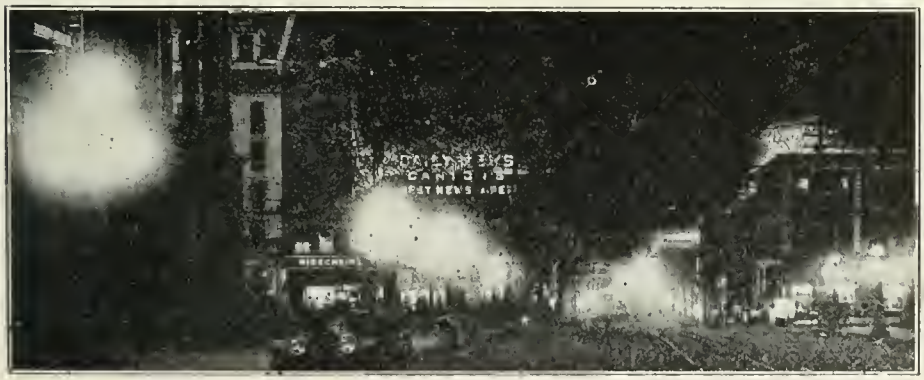
The Sun gasolabra, shown in the photograph is the product of the Sun Vapor and Gas Street Light Co., of Canton, O., and is said to produce about three times the actual candle power in electric standards of similar design using tungsten lamps inside the cluster globes. The character of the lights and of the illumination of buildings is indicated in the photograph but not given full justice.

The Canton, O., installation began two years ago with fifteen 5-way cluster gasolabras on one block and has developed until there are now about 150 in service, all maintained by the business men without expense to the city.

The ordinary 5-lamp electric standard produces 400 candle power or less, according to whether 40, 60 or 100-watt lamps are used. A 5-lamp gasolabra produces 750 candle power, being 150 candle power from each of the five double burners. With natural gas the candle power is increased to about 1,000.

A variety of designs of posts and lamp supports for one, two, three, four or five single or double burners is offered in the company's catalog, with one upright burner and two or four inverted burners. The Sun Street Light Co., Canton, O., will furnish full particulars.

GAS WHITE WAY *at Canton, Ohio, showing satisfactory illumination of street and buildings with five-light gasolabras.*



ROADS AND PAVEMENTS

The Perfection of the Modern Street Pavement

By Frank W. Cherrington.

The slogan "Good Roads" has been made a national issue. Municipalities would do well to paraphrase this expression to "Better Street Pavements."

In the development of a perfect paving material municipal engineers have held steadfastly to one ultimatum; it was essential that such material should permanently resist the abrasion of constantly increasing volumes of traffic. The stupendous expenditure of time, energy and money annually consumed by street maintenance, could then be diverted toward the installation of additional pavements of a permanent character.

Engineers concede that the modern creosoted wood block approaches closely the ideal paving material, in its durability and desirability, for either residential or business streets. Experience of a great many years has proven conclusively that this material would not wear out under the heaviest traffic, or decay under extreme climatic conditions. It has been satisfactorily demonstrated that it ranks with the highest in all the requirements for durability, resilience, smoothness, sanitation, quietness, cleanliness, dustlessness, ease of installation, and removal for pipe work, lowness of tractive resistance, and, when taking into consideration their longevity, lowness of first cost.

Advances along still further development should be encouraged, as it is only from the collaboration of inventions and suggestions that real progress is made toward perfection.

Blocks with one lug on the end and two lugs on the side, extending the full depth of the block and being an integral part of the same, have inexpensively and effectually solved the last of the perplexing problems involving the permanence of creosoted wood block paving construction. They have successfully withstood many tests of their practicability, under various traffic conditions, extending over a long period of years. The lug blocks represent the highest efficiency obtainable from modern paving engineering, and the engineers interested in permanent street pavements are rapidly including them in their general creosoted wood block specifications.

During the many years that the ordinary wood block pavements have been under close observation, only three factors were found which prevented their permanence and absolute satisfaction. These factors were found to be:

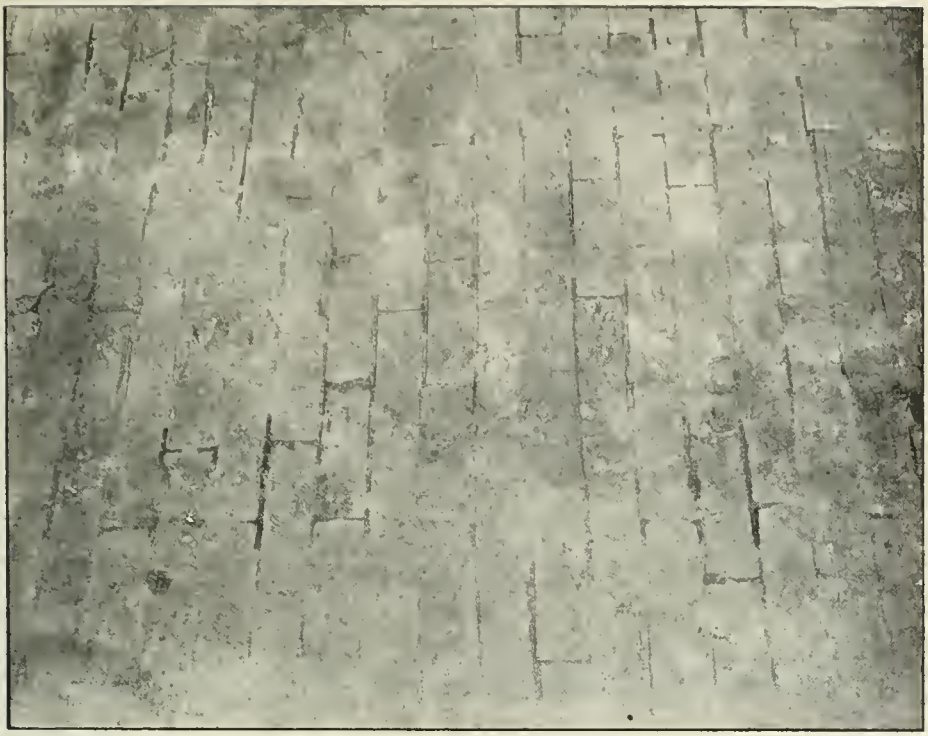
First: The natural tendency of wood block, either treated or untreated, is to absorb water and to swell or expand. Expansion often proceeds beyond the limits provided in the expansion joints along the curbing, and the pavement then follows the line of least resistance and bulges upward, or buckles.

Second: Bleeding, due to the efforts to prevent this expansion by forcing superfluous injections of creosote oil into the wood as a means of waterproofing the blocks. This practice, until recently generally followed, succeeded in only partially waterproofing the block, so that buckling still occurred with startling frequency. The resultant action of the combined forces of the expansion of the wood, the surplus creosote and the air content in the wood cells caused the surplus creosote oil to bleed or exude to the surface of the pavement, to the great annoyance of traffic and pedestrians.

Third: The slippery condition of the pavement, both on gradients and levels, in wet weather.

These three objections to wood block, altho in existence for over fifteen years, have not been sufficiently serious to prevent its adoption on a large scale by almost every city of importance. However, these objections have retarded its general adoption as the standard for municipal street pavements.

Lug blocks absolutely eliminate all three of these problems affecting the permanence of creosoted wood block pavements, and they may now, without fear of contradiction, assert their claim to the perfect paving material.



KREOLITE LUG BLOCK *pavement on Jackson avenue, Toledo, Ohio, June* 27, 1914. *These blocks were laid in the early summer of* 1912. *They are three inches deep, with sand filler. Grade about four per cent.; heavy travel; no cobbling or brooming of edges. Note crushing of some of the lugs on ends of blocks, thus taking care of expansion without bulging.*

Countless experiments have been made during the past fifteen years, in varying the method of the preservative treatment of wood blocks, and changing the quantity and quality of the injected creosote oil. All such experiments have shown the futility of trying to prevent that unchangeable law of nature, the phenomena of the expansion of wood when absorbing moisture. The injection of large and small quantities of creosote oil, whether it be a pure distillate or a combination of creosote oil and coal tar, will do no more than partially waterproof wood block. It has been found that no matter how carefully specifications are prepared, there is a possibility of the ordinary rectangular creosoted block, sooner or later, expanding or buckling. The one practical method of guarding against this possible emergency is to provide a careful, uniform spacing between the ends of the blocks as laid. But it is an impossibility to force laborers to gage correctly a proper and uniform space in laying the blocks. If ordinary rectangular blocks are used the method of spacing should permit the free and unrestricted expansion of the blocks, guarded in some manner by spacers.

Lug blocks automatically provide for this uniformity of spacing by the lug protruding one-fourth inch from the center of one end of each block. This lug is an integral part of the block, and extends its full depth in the direction of the grain. Any laborer is able rapidly to lay lug blocks with an absolutely uniform spacing between blocks. As the lug blocks absorb moisture and expand, either longitudinally of the street or transversely, these lugs are compressed, allowing the pavement to take up any excessive expansion within itself, without bulging. Since it is never possible to foretell just when an ordinary rectangular creosoted wood block pavement will expand, the lug blocks provide a very desirable factor of safety, preparing the pavement for any possible emergency.

Many large railroad systems of both this country and Europe are annually creosoting great quantities of large dimension structural, bridge and cross-tie timbers with so small a quantity as four pounds of oil per cubic foot of timber, and are prolonging their service twenty

or thirty years beyond their normal untreated life. Paving blocks in this country, of very small dimensions, have been treated with such excessive quantities as twenty to twenty-two pounds of creosote per cubic foot of timber, not because such large quantities are necessary to prevent decay, but in an effort to so waterproof the blocks that swelling or expansion would be prevented.

New York and Boston first treated wood block with eighteen pounds of oil per cubic foot of timber. Buckling occurred and this quantity was increased to twenty to twenty-two pounds per cubic foot, but it was found that even then the blocks continued not only to buckle, but to bleed profusely in warm weather. The specifications for creosoted wood block of many municipalities are now reducing the quantity of oil required to be injected from twenty to sixteen and twelve pounds per cubic foot, and, since it has been proven that heavy injections of oil do not prevent expansion, the probabilities are good for still further reduction. An injection of twelve pounds of creosote oil per cubic foot of timber is the maximum quantity used abroad for treating paving blocks, and is more than sufficient to preserve the blocks indefinitely from decay. With expansion provided for by individual expansion joints, or lugs, on each block, it is then necessary to treat only to preserve.

At present experts disagree as to the true cause of bleeding in wood block pavements, but all are agreed that it is greatly increased by the surplus quantities of oil injected into the wood. The quality of the injected oil does not seem to affect the tendency of the blocks to bleed. Lug blocks treated with twelve pounds of creosote per cubic foot not only prevent bulging, but at the same time reduce bleeding to a minimum. The smaller the amount of injected oil, the less trouble there will be from bleeding.

Creosoted wood block pavements are no more slippery in inclement weather than sheet asphalt or other composition pavements, but still this objection remained to be eliminated before perfection was attained.

Several unsatisfactory methods of preventing slipperiness have been tried, but the only practical, economical and efficient method of construction is to provide two lugs, spaced about five inches apart on one side of each block, in the same manner as the end lug above described.

These "Kreolite" lug blocks are not awkward to install, and may be laid as rapidly as ordinary rectangular blocks, since the lugs are an integral part of the block they show no tendency to work to the surface of the pavement, and since they extend the full depth of the block they will not wear smooth under traffic.

A sand or bituminous composition may be used as a filler for the interstices made by the lugs. In either case, excellent results have been secured. When a sand filler is swept into the joints, the sand unites with the creosote on the side of the block and forms a waterproof mastic.

Another advantage of the lug block is the impossibility of any workmen placing the blocks in position with the grain horizontal instead of perpendicular to the surface of the pavement. It has often been demonstrated that workmen, in laying blocks of the same depth and width, are unable to determine quickly which side of the block should be placed up. It is very evident that the wearing surface of wood placed with the grain parallel to the surface of the pavement does not resist traffic abrasion for any length of time, while wood placed with the grain vertical to the surface of the pavement will wear indefinitely, as a mallet, slowly and uniformly.

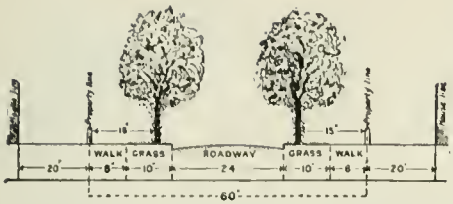
Having successfully solved the problems involved in the elimination of bulging, bleeding and slipping of the ordinary rectangular creosoted wood block construction "Kreolite" lug blocks have gone far toward the development of the long sought perfect permanent street paving material.

Evolution of a Business Street

THE solution of the problem of the congestion that is found in the main streets of towns is to plan residential roadways so that they may be transformed gradually into business streets at a minimum of expense. One way in which this may be done may be understood by a glance at the accompanying illustrations.

The upper diagram shows a street 60 feet wide and suitable for a residential section. The roadway is of moderate width, sufficient to accommodate the light traffic of delivery wagons, carriages, etc., that serve the houses on either side. A boulevard and trees give it a pleasant appearance, and, also, the houses are set back 20 feet from the property line, with gardens or lawns between them and the sidewalk.

If commercial interests should invade this region, property owners would, under ordinary circumstances, build forward to the sidewalk, partly to use the extra space, but chiefly to bring store windows flush up to the causeway. A portion of the street in process of transformation presents a very ragged appearance, due to the lack of a uniform building line. When the process is complete, the once beautiful residential street has become a congested



LAYOUT OF RESIDENCE *street with twenty-foot reserve in front of building line.*

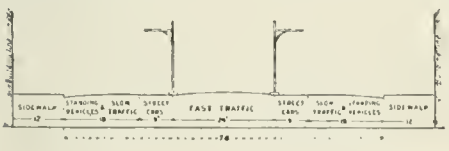
business thorofare with narrow walks and a 44-foot roadway. To widen it would necessitate the tearing down of valuable buildings and would be a heavy expense to the taxpayers.

Foresight would obviate this undesirable development. All that is necessary is to establish a restriction prohibiting the use of land for building beyond an established line. Legally, of course, this involves compensating the property owners, but the damages can be distributed over a long period in a simple way. No property rights need be acquired by the municipality until application is made for a building permit on an obstructive site, and then the restriction can be imposed and paid for. In this way the public thorofare is gradually widened at exactly the same rate as the growing commercial interests require. At no time is it necessary to pull down buildings. When any considerable number of property owners require it, the walk may be moved over to the building line and the roadway widened. The trees should be left as long as possible, and, unless a street railway is constructed, should be a permanent feature.

The lower diagram shows the ultimate development of the 60-foot street into a 100-foot thorofare. Safety for pedestrians crossing the wide roadway is provided by "islands" at the base of each pole holding the electric wires. Motor-cars may run up and down the middle unimpeded by slow-moving wagons and drays, while the latter have ample room to pass between the street car tracks and standing vehicles by the sidewalk.

In connection with the above it is interesting to compare the following extract from a recent address by Mr. Raymond Unwin, F. R. I. B. A., before the Victoria League Imperial Health Conference in London: "There are certain requirements of town planning which are fairly obvious and generally applicable, such as the prevention of the overcrowding of dwellings, and the fixing of such a building line on all the main highways radiating out of the town into the country, as will prevent buildings being erected so near to these roads that future widening can only take place at excessive cost after demolition of the buildings."

SAME STREET *after it has developed for business purposes, with reserve condemned and thrown into sidewalk and roadway.*



The Cost of Good Roads

Approximately $206,000,000 was spent last year on public roads in the United States, according to statistics prepared by the U. S. Department of Agriculture. In 1904 the total was only $79,000,000. In nine years, therefore, the increase has been over 250 per cent.

This awakening on the part of the country to the importance of good roads has, experts say, been due in great measure to the principle of state aid to counties and other local communities. New Jersey began the movement in 1891, when it passed its State Highway Law. Massachusetts and Vermont followed a year later, but for the most part the other states were slow to move. In 1904, only fifteen had state highway departments; today there are only six that have not. In 1913, the individual states appropriated a total of $38,755,088, to supplement local expenditures.

The value of this state aid is, however, not to be measured by the figures alone, for the bulk of the money comes, and always must come, from the counties and townships. Thus, in 1912, the cash outlay by counties, districts and townships, was $137,493,985. Complete figures for 1913 are not yet available, but it is safe to estimate the sum at approximately $151,000,000. To this must be added some $15,000,000 to represent the value of the labor contributed instead of cash in districts where this practice prevails. Last year, therefore, local communities contributed, in round numbers, one hundred and sixty-six millions of dollars, as against appropriations from state treasuries of $38,755,088. The true importance of this thirty-eight millions lies in the fact that it means expert supervision of the expenditure of a considerable portion of the vast sum of two hundred millions. When each county built as it chose and when it chose,

GRACEFUL *concrete highway bridge with light appearance, due to use of ribbed concrete arches.*

the services of trained engineers were usually out of the question. There was little opportunity to test innovations, little advance in the science of road-building, and there was also difficulty in arousing each county individually to do its best to improve conditions within its own limits. State aid has changed all this. The best engineering skill is available for all works of importance, there is cooperation and a constant stimulus to further improvements. The money contributed by the states not only builds more roads, but it makes better those that other money builds.

At the present time there are in the United States 20,741 miles of roads improved either wholly or in part by state aid. This is nearly the mileage of the French routes nationales, the system of great national highways which is the envy of every civilized nation. The routes nationales are, of course, only a small part of the total mileage of France, where practically every road of any importance is an improved road, and France is a much smaller country, both in area and in population that the United States, so that this comparison is not, in itself, very flattering to our progressiveness. It shows, however, that we have at least made a beginning. Of the 2,226,842 miles of roads in the United States, 233,774 miles, or approximately 10 per cent., are classed as improved.

A Ribbed Arch Highway Bridge

The general lines of the concrete arch bridge are in themselves harmonious, a fact which is fortunate considering the large number of bridges designed without architectural supervision. But in some locations, especially where the approaches consist of deep fills and the roadway is carried at considerable height over the stream bed, the concrete arch has too massive appearance for greatest beauty. In some of the larger city bridges of recent construction, arch ribs have been used with a skeleton system of columns and beams supporting the bridge floor slab. While this was primarily developed to save yardage of concrete, by designing each member to carry its full permissible load, yet the results have been most pleasing in appearance and have given to the bridge designer an opportunity to combine the lightness and freedom commonly associated with suspension bridges with the most permanent material—concrete.

An example of ribbed arch design was built for the city of Fulton, Missouri, to span a creek within the city limits. It replaced an old light steel span whose removal was a part of considerable road and bridge reconstruction by the Fulton Special Road District.

General plans were prepared by the road district engineer and bids were solicited from contractors, which were to include a detailed design based upon the general plan. The appropriation for the bridge was scarcely enough to do the work. That the arch ribbed type was chosen for a span of 66 feet under these conditions, indicated an economic advantage afforded by arch ribs which might be used much more widely.

The bridge slab accommodates a roadway 24 feet wide including a sidewalk.

The arch has a rise of 15 feet and the two ribs are each 4 feet wide and spaced 18 feet center to center. The foundations go down 6 feet to rock. The floor system is a concrete slab supported on cross girders which are in turn supported on columns rising from the ribs, with the exception of the center two girders which rest directly upon the ribs. In order to anticipate cracks in the slab at points of flexure, expansion joints were provided for over each of the two cross girders at the crown of the arch. It is not thought that a deflection sufficient to require expansion joints will occur between these points and the abutments.

The roadway was designed to carry a live load of 200 pounds per square foot uniformly distributed, or a concentrated load of a 20-ton road roller, and the sidewalk to carry an 80-pound uniform live load. The stresses permitted in concrete and steel were 600 and 16,000 pounds per square inch respectively.

The abutment consisted of end walls and wings, the latter being strengthened by two inner buttresses.

Unlike the usual arch bridge practically all of the concrete is subject to stress so that a 1:2:4 mixture, using a good quality of crushed limestone and clean river sand, was used thruout. The material was such that a uniformly light concrete resulted, and with the exception of the hand rail, no part of the surface was brushed or painted to better its appearance. The reinforcement consists of square corrugated bars.

The arch was designed and built by Abbott & Wagner, contractors of Kansas City, Mo., and built under the direction of W. R. Heagler, engineer of the district. Universal cement was used.

Objects of the Indiana State Highway Commission

The State Highway Commission of Indiana, recently appointed by Governor Ralston to examine into road conditions and road laws of the state, held its first meeting with the advisory commission in the Senate chamber of the State House, July 15. President Harris' address to the commission was notable in explaining the present road laws and road conditions in the state and outlining the work that the commission is expected to do, and included the following points:

The Governor has created this commission to investigate and consider means and measures for unifying, simplifying and improving the present system of constructing and maintaining public roads.

Indiana is approaching her first centennial. Its population is three millions; that is one hundred persons to each square mile. Great advancement is being made in agriculture. Manufactures are increasing thruout the state. The population and business of the state will naturally multiply rapidly in the future. The agricultural and industrial interests, as well as the people at large, are insisting that the public roads shall be made better, both in construction and maintenance.

Good roads all the year round are necessary for general thrift, progress and comfort. And it is felt thruout the state that the time has come that a better system might be provided than the present laws afford. The present system of laws for the construction and maintenance of public roads may be summarized as follows:

All public roads belong to the state and are under its legislative power and control. Yet no state tax is levied on the people and property at large to provide good roads thruout the state. The only existing provision of this kind is the automobile tax, which is estimated in the office of the secretary of state to raise for the year 1914 about $400,000. Aside from this fund the state itself contributes nothing for the construction and upkeep of the roads of the state.

The state statistician has prepared the following statement:

Number miles gravel roads Jan. 1, 1914	26,364
Number miles unimproved roads Jan. 1, 1914	36,461
Number miles gravel road constructed 1913	1,740
Gravel road repairs 1913	$ 2,017,205.37
Bridges and bridge repairs 1913	2,001,129.32
Road tax worked out June settlement 1913	855,469.10

Township gravel road bonds outstanding:

January 1, 1910	$17,089,476.37
January 1, 1911	20,501,175.44
January 1, 1912	23 441,332.37
January 1, 1913	27,489,262.26
January 1, 1914	30,950,587.94

The statistics are not complete for 1913, but those for 1912 show that the taxpayers paid out for roads in one form or another in 1912, as follows:

Gravel road bonds and interest	$3,876,881.43
Paid for new roads	5,611,403.28
Expended on bridges and bridge repairs	1,429,918.33
Expended on gravel road repairs	1,802,925.33
Paid viewers	33,326.98
	$12,754,455.35

Amount expended by townships:

Road tax worked out	1,832,407.58
Road tax paid in cash	445,365.46
	$15,032,228.39

There are 1,017 townships in the state, and under the present system the officers and people in each township improve or do not improve the public roads there is they may determine for themselves. Each township has power to improve the public roads therein, with such material and in such way, as such township may determine. They may use any material and mode of improvement they elect, without much regard to the kind of material or improvement, if any, made in the adjoining townships, even on the main roads crossing the township. In short, the present law provides for a sort of miscellaneous patchwork system both in the kind and in the extent of the improvement. For example: If there is a main traveled road between two or more counties or cities crossing several townships in its course some parts of the road may be made of gravel, some of stone, some of cement or brick and the like, and other parts not even improved at all. It cannot be otherwise until there is some general state system provided requiring more uuity and concord of action along the line of that road. Indeed a township may improve its by-roads, and leave the main roads as they happen to be, whether good or bad.

Again, as to the cost. The people of a township are not able to pay all cash down for any important improvement made on a road, and so provision is made to the effect that non-taxable road bonds may be issued in annual series running for ten or twenty years, bearing interest at 4½ per cent. per annum. While these bonds are issued by the County Commissioners they are, in law, only a charge upon the property of the township. It will be seen from the above statement of the Statistician that these bonds are increasing rapidly from year to year. The interest charge on these bonds alone is nearly $1,500,000 annually, to which must be added the yearly maturing bonds.

Thus the permanent roads within the state are under no uniform system, but each township on its own initiative makes such improvements of such roads as the people and officers thereof from time to time determine. Moreover, probably one-third of the entire population of the state live in the cities and towns who, generally speaking, contribute little or nothing to the construction of the general highways of the state.

Now as to the repairs. The duty of repairing the improved roads is by our laws laid upon the counties, each to keep up the roads within its jurisdiction. The county authorities annually levy a road tax, which is used in the up-keep of the roads and maintenance and repair of bridges. This tax is paid in cash. The work is now done under the supervision of the county highway superintendents and their assistants. The townships levy a tax for the maintenance of the unimproved roads in the townships, payable in cash and labor.

The Act of March 15, 1913, authorizes a township road tax of not more than thirty cents on the hundred dollars to be levied on all property in a township outside of the corporate cities and towns. To this may be added a levy of ten cents more on the hundred dollars for the construction and repair of bridges and culverts and for other road purposes.

It is estimated, in round numbers, that 5,000 persons in all have to do officially in various ways with the administration of the system of building and maintaining the public highways thruout the state. There is no requirement of knowledge or competency for the discharge of these duties. There is no unity in method or organization, or state regulation or supervision, direction or control. Little or nothing is being done for the safety of the traveling public at railroad crossings, where accidents of maiming and death are occurring daily.

A new power is coming into general use upon the public highways which will rapidly increase in the future. The ordinary gravel road is found insufficient to resist the stress and force of automobiles, trucks and the like; and so a new problem is presented.

Can a better and more uniform and business method be had for constructing and maintaining our public roads, commensurate with the present and future growth and needs of the state? The answer must be found, if at all, in patient and careful investigation in the light of the experience of the people of this state and other states and countries.

It is the purpose of this commission to take up the problem and return to the Governor such answer as the facts may finally determine. And in this investigation the commission solicits the help and counsel of the people and the press thruout the state.

After the address many valuable suggestions were made by the members.

It was decided to hold, during the month of September, a public hearing in each Congressional District, meetings to be determined later. The county commissioners, highway superintendents and township trustees will be asked to make reports to the commission and to these meetings, of the conditions in their respective counties.

Demarcus C. Brown, State Librarian, will collect information relative to the work from the federal government and various states.

There were present of the Highway Commission: President A. C. Harris, Thomas Taggart, W. H. O'Brien and

Leonard H. Clore, and Luke W. Duffey, Secretary. Prof. R. L. Sackett, also a member, was not able to be present. Members present of the Advisory Committee of fifteen, appointed one from each Congressional District, were: William Jones, Fairmount; Maurice Douglas, Flatrock; Lewis Taylor, Newburg; D. F. Maish, Frankfort; J. G. Short, Hillsboro; Mike Duffey, Fowler; Albert P. Fenn, Tell City; Senator George V. Kell, Ft. Wayne; Oliver Kline, Huntington; William F. Franklin, Danville; L. Newt. Brown, Franklin; C. A. Kenyon, Indianapolis; John R. Retherford, Muncie; Aaron Jones, South Bend; and Prof. E. R. Cumings, Bloomington.

The Passing of the Road Boss

Being an interview with Old Man Winters. By John N. Edy.

"No, Sir-rce, I'm not the 'Road Boss.' I'm a taxpayer and a property owner, and I live on this road. But I'm a farmer and not a road-builder; and if you've got any kicks to register, just hunt up the road superintendent and tell him your troubles."

"Old Man" Winters was about to throw in the clutch and drive on, when I detained him with my explanation.

"But, Mr. Winters, I have no kicks to register. On the other hand, I wanted to congratulate the road supervisor upon this beautiful piece of roadway. Although you do not recognize me, I remember you as the most prominent road boss of fifteen years ago. My name is Frank Edwards. Father used to say that you were the best road man in the county."

The old gentleman took a good look at me, and then sat back in the seat of his runabout and laughed. I hadn't seen anything particularly laughable, and was naturally quite relieved when he grasped me by the hand and said kindly:

"Well, Frank Edwards, I've wanted to get hold of you ever since you and that devilish brother of yours threw a dead cat in my cistern. Let's see, that was nearly sixteen years ago, wasn't it? And you remember me as the road boss? Well, well. You surely have been out of touch with this country. Don't you know that we have good roads now? Did we used to have them? No? Then you ought to know that we have adopted more business-like methods of handling our highway affairs. But, then, you've been gone a long time."

"Fifteen years is a long time, Mr. Winters," I replied as I stepped into the car and sat down beside him. I had been out for a hike over the country roads, and this invitation to ride was thoroly acceptable to me.

We were bowling along at a lively clip, skimming over the smooth surface of the country road; up and down hills that I failed to recognize because of the easiness of ascent. The bridges and culverts we crossed seemed out of place, as my memory took me back to the old wood structures spanning unsightly streams. Not only did the road and bridge improvements appeal to me, but on every hand there were indications of progress and development. The farms looked different—they looked good. Tumble-down rails had given way to the neat, uniform lines of substantial fences. The road ditches were free from debris of every kind, beautiful shade trees stood in artistic relief against the sky. In all of these surroundings I could see no resemblance to the roadside conditions that I had known as a boy.

"You see, Frank, when your father and I were neighbors we didn't have any roads to speak of. We had to look after our farms as best we could, and get to town as best we could over roads that we had to 'work' between times. Working the roads kept us in the hole most of the time.

"I was the road boss for a long time, and I tried hard to keep the mudholes filled and the old bridge floors patched. When we could haul a thousand pounds we thought the roads were in fine shape. We thought that because we didn't know what a real good road was. I didn't know what 'macadam' meant, and my way of fixing mudholes was to dump about twenty-five loads of rock in the hole and then wait for it to dry out so I could move the rocks out of the way. I used to wonder why the next rain always showed two mudholes instead of the one I started with."

"I know, too, that we moved a lot of dirt that we shouldn't have moved. You remember that we worked the roads with the big grader. That was the only machine or tool we knew. I've ruined several horses in my road building days, just because I didn't know how to operate the grader properly. And of course we didn't know anything about the road drag or of the cheap means of maintaining roads. In fact, there was no maintenance; it was all construction and reconstruction and destruction.

"Now, then, what made all this change that you see? Don't think that I did it, or that Bill Perkins did it. We helped, that's true, but I don't take any credit for that. We were at the end of our string and about down and out. The whole neighborhood was ready to quit. I was just about to follow your father out West, when the thing happened. The thing came in the shape of a Government bulletin on road building. I didn't get any other mail that day, and on the way home from town I read that pamphlet through from cover to

cover. What's that? Rural delivery? Well, I should say not. We never had rural delivery to amount to anything till we got good roads.

"Now there was something in that bulletin that made me think. The man who wrote it said a lot about road-building being a business. He said it took engineering brains to build good roads and bridges, and that a farmer could make more money as a farmer than he could as a road-builder. Then there was something about the readiness of the Government to co-operate with communities in planning their highway system.

"You can well see that here was interesting news for me. I had never looked on road-building as a business; and I had never stopped to consider how much more money I might make as a farmer if I had all my time and energy to devote to it. As for the reference to a highway system, I just couldn't figure it. But, anyway, the next day I saw Bill Perkins, and we read the bulletin together; and after we'd talked it over, we decided to put it up to the county commissioners. Of course the commissioners didn't give us much encouragement; they said we'd better call a meeting of the taxpayers, and if everybody wanted it, they'd get a Government man to come and look the proposition over.

"Let me tell you, it was some job to get the men to go in for the idea. I don't believe we would ever have succeeded if it it hadn't been for the women. Some of them got together after church one Sunday and decided that they wanted the Government road man. They said they wanted better roads so the children could get to school every day; they wanted to be able to get to town to shop, to hear lectures, and to enjoy other privileges that were withheld because of poor roads. The women wanted a lot of things that we men had never thought of; in fact, we hadn't considered our wives and children at all.

Mr. Winters stopped and looked at his watch.

"Shall I have Roy drive us in now, or will you reconsider and stay the night with us?"

"Thank you, but I must be in town before six o'clock," I told him; "but have you finished your story?"

"Why, yes," he answered. "I've told about all there is to tell. Of course the Government road man came and looked over the whole county. He stayed about three weeks making maps, plans and estimates, and gathering samples of rock, gravel, clay, etc., to send to Washington to be tested. He said he thought he could work out a system of roads that would be beneficial to us, and he did. Before he went away we had begun to realize just how little we knew about the business of road-building. He filed his plans and report, and told us how we might get the roads we wanted. And the first thing he recommended was the engagement of a road superintendent.

"We adopted the report, and hired a competent road-builder to carry out the plans. Before long we heard from Washington regarding the tests of our road material; would you believe it—we found that our deposits of road-making materials were the most valuable in the state, and worth millions of dollars to us. The Government man had showed us a law that permitted us to issue bonds for the construction of roads and bridges, so it wasn't long before we began to see our way out of the difficulty. Built our good roads on borrowed money, that's what we did, besides that, some of us put our teams on the road and got back more than enough to meet the first assessment. I don't believe any one of us has missed the money that paid for these improvements.

"When the main roads were finished we fellows were out of a job, so I went back to farming. And not having anything else to do, I thought a lot about intensive farming. The result was that I put in a big patch of garden that netted me $1,500 that year. From that time on I've been a real farmer, and it's been worth while. I'm like Bill Perkins now—I can't afford to fool with the roads. And I believe every other man in this valley will say the same thing. We've got our system of roads and our organization that cares for them. We have a construction fund and a maintenance fund. The taxpayers pay the bills, of course. But after more than ten years of good roads I can prove that they haven't cost me a cent. My farm has increased in value more than enough to buy a whole mile of road. And when you consider the other advantages—educational, moral, sanitary and social—why, I wouldn't trade a year in this prosperous and contented community for a lifetime in a place that had bad roads."—*Successful Farming.*

Non-Corrosive Metal for Spraying Nozzle

In response to the inquiry on p. 33 of the July number of MUNICIPAL ENGINEERING for a metal for irrigation spraying nozzle not so corrosive as brass, Hoyt Catlin, of the Newnan Water and Light Commission, Newnan, Ga., refers to Monel metal as possessing the necessary quality, but on inquiry the More-Jones Brass and Metal Company, St. Louis, Mo., says that inasmuch as the ingredients include fully 20 per cent. of nickel, with a very high melting point, the price would be almost prohibitive for the purpose mentioned.

Municipal Notes

Competition on Plans for Neighborhood Center

Last year, in connection with its Housing Exhibition, the City Club of Chicago held a competition for plans for laying out a typical quarter-section of land in the outskirts of Chicago. Thirty-eight sets of drawings were submitted, the majority of which are now being prepared for publication by the club. The volume will be ready the coming fall.

This year the City Club will hold a competition for plans for a Neighborhood Center. The object of the competition is to bring before the public in graphic form the practical possibilities of enhancing neighborhood life in our cities by better and especially better grouped buildings and grounds for neighborhood activities. The drawings submitted in the competition will be shown as the special feature of an exhibition and a series of conferences on the subject of Neighborhood Centers, to be opened at the City Club, Tuesday, February 9, 1915. The club also reserves the right to publish in pamphlet or book form all drawings and theses submitted.

One of the past presidents of the City Club has offered $600 for the purposes of the competition and this amount will be awarded by a jury.

The drawings in the preliminary competition are to be delivered at the office of the City Club, 315 Plymouth Court, Chicago, at or before noon of Monday, November 9, 1914, addressed "Neighborhood Center Competition." These drawings will not be made public until the close of the final competition.

As soon as practicable after the close of the preliminary competition a jury of five members, to be chosen by a joint committee of the Illinois Chapter of the American Institute of Architects and of the City Club, will select from the plans submitted not less than eight or more than sixteen which they deem to be the best. The noms de plume of the authors of the winning plans will then be publicly posted in the main lobby of the City Club, and a list of such noms de plume will be mailed to all persons who have registered in the competition. The authors of the plans thus selected shall be eligible to participate in the final competition and should proceed without further notification with the drawings therefor.

The drawings in the final competition are to be delivered at the office of the City Club, 315 Plymouth Court, Chicago, at or before noon of Monday, January 25, 1915, addressed "Neighborhood Center Competition."

As soon as practicable after the close of the final competition, the jury will award first, second and third honors to the three sets of drawings which they deem the best among those submitted in the competition. The jury may award honors to more than three if in their judgment special circumstances demand such action. The jury will also select the eight sets of drawings which they deem the best among those submitted in the competition, and the sum of $600 will be divided equally among the authors of those eight, to cover in part the expense of preparing the drawings. A set of drawings as specified in this and the preceding paragraph will comprise a plan submitted in the preliminary competition and the drawings submitted by the same author or authors in the final competition. All drawings shall be the property of the authors, subject to the club's right of possession for publication in book form.

Inquiries for further information should be addressed in writing to "Neighborhood Center Competition," City Club, 315 Plymouth Court, Chicago. The answers will be in writing and will be forwarded, with the questions, to all competitors.

Water Filtration for Little Falls, N. Y.

City Engineer O. J. Dempster, of Little Falls, N. Y., in his annual report again calls attention to the need of a filter for the water supply, which will remove the

objectionable sediment, and safeguard against possible pollution. Owing to the then apparently large cost, the lands around Spruce reservoir were not entirely purchased when the city acquired that source of supply, and now many cottages have been erected. It is impossible to adequately guard against all sources of pollution, as a chance trespasser might cause an epidemic as those at New Haven, Conn., in 1900, in Ithaca, N. Y., in 1903.

The filter bed on Spruce is useless and the coke bed at the distribution reservoir has little sanitary efficiency, if any, as it is but a roughing filter and will remove but the very coarse sediment, and then only when the reservoir is nearly full so that the filter can be washed. The method of washing is inadequate and inefficient.

In June the distribution reservoir was gradually drawn down to a low level. There were high winds at the time so that the sides of the reservoir were washed and a large amount of sediment was carried into the coke bed, clogging it, and then being carried into the distribution system, as the filter cannot be washed when the surface of the reservoir is more than 2 feet below the spillway. If the coke had been new before the time of low water the results would have been the same.

The science of water purification has been studied but a comparatively few years and might still be considered to be in the experimental stage. However, rapid progress has been made and excellent results have been obtained in the last ten years, and it is safe to say that a filter could be designed which would give absolute protection from objectionable sediment and possible tho not probable, pollution.

Sewer Construction in Des Moines, Iowa

The original sewer plan for the city of Des Moines, Iowa, begun in 1879, contemplated a system of combined sewers with outlets to the Des Moines river at or near the Raccoon Forks. This design was followed out completely in the downtown portions but in the late years it has been found more satisfactory to dispose of storm water directly into the rivers or tributary creeks in the upper part of the city, and carry only sanitary sewage to the lower outlets. However, 128 miles of the total length of 137 miles may be regarded as combined sewers. The remaining 9 miles, which consist of strictly sanitary sewers, have been built on outlying slopes where the topography does not permit gravity outlets into existing sewers. Two small systems in the west end of the city, put into operation during the past year, are served by automatic electric pumps which elevate the sewage sufficiently to permit the discharge into existing sewers. These systems have a total length of 3½ miles and serve about ⅜ of one square mile of territory. Two other sanitary systems also in the west end, which have been operating five or six years, are taken care of by septic tanks and filters, and thence discharge into small creeks. These systems have a length of 5½ miles and serve about ½ of one square mile of territory. The total area served by existing sewers is about 9 square miles.

CONCRETE SEWER, *Des Moines, Iowa, 3 feet wide by 3.5 feet high; trench 20 feet deep, 4 feet wide.*

Large additions to the present system are now contemplated. In the east end of the city the seventh ward sewer system is already under contract. This is a sanitary system comprising about 20 miles of sewers, which will serve an area of about 2½ square miles. The outlet of this system is at the Des Moines river near the southeast corner of the city, and farther down stream than any present outlet.

In the west part of the city preliminary surveys have been made for two large sanitary intercepters, one northwest and the other southwest. These sewers will provide service for an area of about 4½ square miles and are expected to allow for several years' expansion in these directions. Outlets at both of the present septic tanks will be diverted to these intercepters thus doing away with maintenance charges at the disposal plants. Both intercepters are to be carried down to

points close to present sewers, where pumps will be placed and the sewage elevated so it can flow by gravity to the regular outlets.

The remaining step will then be the construction of a large main intercepter down stream along the Des Moines river to East Thirtieth street which will also be the outlet of the seventh ward system, and the construction there of a complete disposal plant to serve the entire city.

The photographs show the Woodland avenue sewer system under construction the extent of which is shown by the following statement of lengths and sizes:

2,328 feet of 3 feet by 3½ feet reinforced concrete.
330 feet of 2 feet by 3 feet reinforced concrete.
957 feet of 24-inch pipe.
2,017 feet of 20-inch pipe.
977 feet of 18-inch pipe.
2,466 feet of 15-inch pipe.
1,521 feet of 12-inch pipe.
6,469 feet of 10-inch pipe.

17,065 feet total.

The concrete sewers were built of a mixture of one part cement to five parts of unscreened gravel. The larger sewer was reinforced with ⅝-inch square section deformed bars placed 6-inch centers on the roof and 18-inch centers on the side walls, with ½-inch longitudinal bars spaced 12-inch centers. The reinforcement of the smaller section was the same as of the larger, excepting that ½-inch bars were used in place of ⅝-inch bars.

A sub-drain was placed under the entire length of the concrete sewer, so that all ground water was drawn away before placing the concrete.

The J. W. Turner Company has built about 20 miles of sewer in the same section of the city of the same nature, tho not of the same depth. The trench machine shown in the photograph cuts a trench anywhere from 28 to 60 inches in width, and up to 20 feet in depth. A larger machine cuts 6½ feet wide.

In laying pipe sewers the company usually operates with about fifteen men, and, with the back-filler in use as shown in the photograph of the pipe sewer, one team is sufficient to keep the machine supplied with water and haul lumber and tools ahead of the work from time to time. When not using the back-filler it requires from three to four additional teams to replace the earth in the trench.

LAYING PIPE SEWER *in Des Moines, Iowa, with trench machine and conveyor for back-filling.*

☆

When building concrete sewers additional men are required to mix and place concrete, and to place and remove forms. The workmen prefer machine work to hand work, and where working a machine a full gang is usually sure, whereas, on work to be performed entirely by labor, the contractor can never feel sure of sufficient men.

Denatured Electricity

An interesting method of preventing the improper use of electric current has been devised by an Italian engineer. The practice of making especially low rates for current to be used in electric power, heating and cooking devices is becoming more and more general, but with the ordinary constant potential current it is difficult to detect the use of lighting devices on circuits intended only for power and heating purposes.

This engineer advocates the use of special circuits on which the current is subject to extreme fluctuation of voltage at rapidly recurring intervals, which would make it practically impossible to use lamps, because of the flicker in the lights. As the current is not entirely interrupted and the normal voltage is almost immediately restored, the proper operation of power or heating apparatus is not interfered with and the rightful use of the circuits for their respective purposes is assured.

MISCELLANEOUS

Geology for Engineers

The professors of economic geology in Cornell University and the University of Virginia, Drs. Heinrich Ries and Thomas L. Watson, have put into book form the work given to the students in their subject in a new book entitled "Engineering Geology" ($4). Both have been connected with state geological departments and as such have become conversant with the economic side of geology, which Professor Ries has considered in some detail in earlier books and reports devoted to certain classes of industries.

The present book is broader in its scope, covering as it does the rock-forming minerals, the general characters and origins, structural features and metamorphism of rocks, rock-weathering and soils, surface and underground waters, landslides, wave and current action, lakes, glacial deposits; and the uses made of various materials resulting from the causes and combinations previously described, such as building stone, lime, cement, plaster, clay and clay products, coal, petroleum, natural gas, asphalt, bitumen, ores, and road foundations and materials.

The book is fully illustrated, and, while apparently built primarily as a text-book, will be useful to the general and particular seekers for information.

Prizes for Highway Study

Awards have been made in the competition announced several months ago by the Barber Asphalt Paving Company, for papers from engineering students on the subject of Asphaltic Materials for Highway Construction. The judges of the competition, E. J. Mehren, editor Engineering Record, and H. P. Gillette, editor Engineering and Contracting, have made awards of prizes of $100 each to the following contestants:

Frederic O. X. McLoughlin, New York City, Columbia University.

Harry Schindler, Brooklyn, N. Y., Cornell University.

B. J. Fletcher, Parrott, Ga., University of Georgia.

John W. Hill, Chicago, Ill., University of Illinois.

Robert S. Johnson, Ireton, Ia., Iowa State College.

M. V. Holmes, Kansas City, Kans., University of Kansas.

F. P. Gilbert, Beverly, Mass., Massachusetts "Tech."

Harold J. LaLonde, Sault Ste. Marie, Mich., University of Michigan.

Benjamin Wilk, Virginia, Minn., University of Minnesota.

Alvin C. Smith, Lyons, Neb., University of Nebraska.

O. H. Gosswein, St. Louis, Mo., Purdue University.

Alfred A. Berkowitz, New Britain, Conn., Sheffield Scientific School.

W. J. Campbell, Cohoes, N. Y., Syracuse University.

The purpose of the competition was to turn the attention of engineering students to street and road construction as a promising field of work. The company offering the prizes believes that the plan was successful in this direction.

Personal Notes

At the celebration of the fiftieth anniversary of the founding of the School of Mines of Columbia University, the trustees conferred upon Mr. Gano Dunn, president of The J. G. White Engineering Corporation, the honorary degree of Master of Science in recognition of accomplishments and distinction in science and electrical engineering. Mr. Dunn is president of the United Engineering Society and has been president of the American Institute of Electrical Engineers and the New York Electrical Society. He is a member of the British Institution of Electrical Engineers, the International Electrotechnical Commission, American Society of Mechanical Engineers and other scientific and engineering bodies and was United States delegate to and vice president of the last International Elec-

trotechnical Congress which was held in Turin, Italy, in 1912.

John H. Gregory, of Hering & Gregory, consulting engineers, New York, and C. E. Gregory, chief engineer of sewers, Boro of Manhattan, New York, will sail for Europe on July 4th where they will spend the summer studying European methods of sewage and refuse disposal and some of the most recent methods of water purification.

H. L. Cory is city engineer of Baker, Mont.

W. H. Hall has been appointed city engineer of New Britain, Conn.

W. J. Fulton has been appointed city engineer of Gary, Ind.

A. T. Thompson is the new city engineer at Chippewa Falls, Wis.

J. J. Smith is city engineer of Grand Forks and East Grand Forks, N. D.

Theodore A. Leisen has resigned his position of chief engineer of the Louisville Water Company to accept the general superintendency of the water works of Detroit, Mich.

Prevost Hubbard, Assoc. Am. Soc. C. E., in charge of division of roads and pavements, The Institute of Industrial Research, Washington, and lecturer in highway engineering chemistry at Columbia University, and Arthur H. Blanchard, M. Am. Soc. C. E., consulting highway engineer, and professor in charge of the graduate course in highway engineering at Columbia University, have been elected by the council of the International Association for Testing Materials the American members of Commission No. 58 on "Standardization of Methods of Testing and Nomenclature of Road and Paving Materials."

H. A. Strauss, consulting engineer, of Chicago, has been retained by the bondholders' committee of the Alton, Jacksonville & Peoria Railway Company, to prepare a complete valuation of the company's property, to be submitted to the Illinois State Public Utilities Commission in connection with the application for authorization of re-organization of the company and the issuance of stocks and bonds thereunder. This will be the first extensive valuation of an interurban railway submitted to the Illinois commission.

Clarence D. Pollock, M. Am. Soc. C. E., with experience in charge of paving work in New York, Brooklyn, Havana, Cuba, and San Antonio, Texas, announces that he has opened offices in the Park Row Building, New York City, as consulting engineer, and will make a specialty of pavements, drainage, and other municipal problems.

Technical Associations

At a special meeting of the board of directors of the American Road Builders' Association it was unanimously voted to hold a joint meeting with the American Highway Association in 1915, either in San Francisco or in Oakland, during the Panama Pacific Exposition, the exact date to be determined later. The management of this joint meeting will be in the hands of a committee of five made up of two members from each association, the fifth member to be selected by these four.

The Federation of Trade Press Associations will meet at Congress hotel, Chicago, Ill., Sept. 24-26. E. R. Shaw, 537 S. Dearborn St., chairman of committee.

The eighth annual convention of the Illuminating Engineering Society will be held at the Hollenden hotel, Cleveland, O., Sept. 21-25.

The annual convention of the New England Water Works Association will be held Sept. 15-18 in Boston, Mass. Willard Kent, Narragansett Pier, R. I., secretary.

The International Association of Municipal Electricians will meet at Atlantic City, Sept. 20-23. C. W. Pyke, Elcetrical Bureau, Philadelphia, Pa., secretary.

The American Highway Association meets at Atlanta, Ga., Nov. 18-20. I. S. Pennypacker, executive assistant, Colorado Bldg., Washington, D. C.

The American Society of Municipal Improvements meets at the Somerset hotel, Boston, Mass., Oct 21-23. Charles Carroll Brown, secretary, Indianapolis, Ind.

The International Association of Fire Engineers meets Sept. 21-25 at the Grunewald hotel, New Orleans, La. Jas. McFall, Roanoke, Va., secretary.

Publications Received

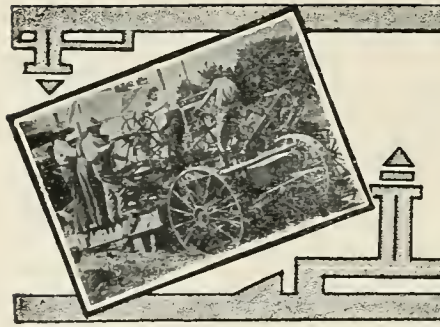
Fourteenth annual report of board of water and lighting commissioners of McKeesport, Pa., for 1913. E. C. Trax, filtration department.

Twenty-seventh annual report of the State Board of Health of Ohio for 1912. W. H. Dittoe, chief engineer.

Main drainage and sewage disposal works proposed for New York city. Reports of experts and data relating to the harbor report of the Metropolitan Sewerage Commission of New York, of April 30, 1914. Geo. A. Soper, president.

Proceedings of the National Conference on Concrete Road Building, held at Chicago, Feb. 12-14, 1914. Issued by the secretary, 208 S. LaSalle St., Chicago, Ill. Paper, 210 pp.

The Discharge of Yukon River at Eagle, Alaska Water Supply Paper, 345-F., U. S. Geological Survey.



MACHINERY AND SUPPLIES

Progress in Road Building

In publishing a new Bermudez Road Book, the Barber Asphalt Paving Company emphasizes the fact that we now have five years' service experience upon which to base judgments as to the durability of asphaltic concrete and macadam. Following out this line of argument, the illustrations are mainly confined to showing roads built in 1909 and 1910 as they look to-day. Among these are several 1909 roads that have cost practically nothing for maintenance. The New York State roads of this era, it is stated, are in much better condition than roads of later date. There are now more than 12,000,000 square yards of Bermudez roads in existence, the equivalent of 1,325 miles of 15-foot roadway. The cover of the booklet is something of a novelty, being a photographic reproduction of the surface of a penetration road, without a seal coat.

Preservative Treatment of Poles for Line Wires

The normal yearly production of poles in the United States is about 2,750,000, and today there are, approximately, over 50,000,000 poles supporting wires, either telephone, telegraph, light, or power. It is only of recent years that the pole user could be induced to take the precaution of preserving his timber.

In the last few years, prompted by their increased price, there is hardly a pole set without the owner's having some idea of preserving it. He begins to compare what he or his predecessor formerly paid for a pole with the present price, hence he begins to figure how to stop the expense of replacing rotten poles.

Since the records obtained in the past years show what ingredients remain in treated timbers the greatest period of time, it is natural to conclude that a good preservative should contain as great an amount of these ingredients as it is possible to obtain. The impregnating process, while one of the oldest methods known is yet in its infancy. The records referred to, however, are based on timbers which had been treated with a tar oil under pressure. This method if properly used is frequently so expensive that the additional cost makes its use prohibitory.

It is the high boiling oils of coal tar which preserve timber, because that is what was obtained by subjecting the preserved timbers to dry distillation. The records do not show whether or not these high boiling oils originally contained any neutral, such as paraffin or similar oils, which have not as yet been proven germicidal.

The average tar oil obtainable, which is forced into timber under pressure, contains from 15 to 35 per cent oil distilling above 300 degrees centigrade. Hence, if an oil that contained 35 per cent distilling above 300 degrees centigrade, at most, which had been injected into the timber showed such excellent results, it is reasonable to suppose that a lesser amount of oil containing proportionally a greater per cent of distillate above 300 degrees centigrade will bring good results when properly applied.

It is important for the one who supposes petroleum to be a preservative to exercise much care in the selection of the petroleum because it may prove an unwise form of economy, as it has repeatedly.

In 1900 the C-A-Wood-Preserver Company began directing attention to the value of high boiling tar oils as against the offered "secret" or "patented" processes in connection with preservatives. Since scientific investigations by the government and others have substantiated these theories and arguments, some are attempting to use preservatives which are the high boiling portions of crude petroleum. These mislead the chemist unless he make the sulphonation test. The company mentioned, in 1886, sold one of the first barrels of coal tar distillate that came to America. This product which was intended for the superficial method, distilled only 75 per cent above 300 degrees centigrade. Eleven years afterward this was increased to 85 per

cent and during the summer of 1909 to 92 per cent. This was the highest mark reached so far and it required special machinery to produce it.

It is practically impossible to produce a successful oil distilling more than 92 per cent above 300 degrees centigrade according to the United States Forest Service method of analysis, as it would solidify at normal temperature if it were free from petroleum residues or similar oils. Some tars will distill much more than 92 per cent above 300 degrees centigrade, but they are not free from the paraffin oils which have a high boiling point tho they are nongermicidal.

While it has been less than a year since a strictly coal tar distillate containing as much as 92 per cent liquid residue (oil) above 300 degrees centigrade (United States Forest Service method) has been manufactured and put on the market, it may be interesting to note a few records and illustrations of the methods of application and results derived from the use of that heretofore produced, or from the oil distilling 85 per cent above 300 degrees centigrade.

After determining the quality of preservative, the pole user is interested in the method of application. The brush method is the simplest and most universally used. Next is the pouring system, which is done in two ways. One consists of a portable tank, while the other is stationary, the poles being conveyed to the treating tank.

Poles which are already erected and which have begun to show decay can be saved by a very simple method. By digging away the earth to a depth of about two feet around the pole, applying two coats of a good preservative with a brush and then replacing the earth, the pole is saved. Rot is caused by a germ and the preservative being a germicide or antiseptic kills those present when applied to the decaying parts and its presence in the wood prevents future decay as well. The manager of the Memphis (Tenn.) Telephone Company, in 1904, made this experiment on cypress poles and he reports them in perfect condition today with every evidence of lasting many years longer. The Austin (Texas) Electric Railway Company has likewise found this a most successful experiment on cedar poles.

Cross arms can be treated by the brush method, however, the complete dipping or immersion is the more favorable. The cost of treating a pole depends upon its size, character, condition, price of the preservative and the amount used—whether it be be treated at the ground line only or the entire butt end. There is a variation from four cents to perhaps a dollar per pole and each user of poles knows best what he can afford to pay for the protection of his timber.

Last, but not the least important, it should be noted that under no circumstances should unseasoned or green timber be treated, regardless of the preservative used; it must be at least partly seasoned to allow penetration.

Universal Portland Cement Co. at the Panama-Pacific Exposition

Approximately 42,000 square feet of space in the palace of Mines and Metallurgy, at the Panama-Pacific Exposition, will be devoted to the exhibit of the United States Steel Corporation. The Universal Portland Cement Company, which is a subsidiary to the corporation, has planned an extensive display. Behind a series of concrete arches will be hung paintings illustrating the most important uses of concrete. In the center arch an actual model of a cement plant will work during the exposition.

The central feature of the exhibit will consist of an actual reproduction on a two-thirds scale of a portion of a factory building, constructed thruout of reinforced concrete. Within this space, which will be used as a reception booth, will be shown a chart describing graphically, and with samples and outline, the manufacture of cement, pictures of the various plants of the company, models of concrete structures and photographs of concrete work.

The other subsidiary companies of the corporation are planning equally elaborate displays. An important feature of each exhibit will be something illustrative of the manufacture of the product which it represents.

To one visiting the displays of the corporation will be presented an opportunity of learning the history, salient features and manufacturing processes of some of the country's largest industries.

A Mixer Designed For Concrete Sidewalk Work

In each city, town or village will be seen some newly completed sidewalk or a new job that is just going in. In many cities brick walks are being ordered torn up by the authorities and are replaced by only one kind of sidewalk—that of concrete. All new walks are of concrete and in all of the new additions and subdivisions, nothing but concrete walks are being put in, together with miles of concrete curb and gutter.

Most of the concrete mixing for this work has been done in the past by both small and large contractors on a mixing board by hand, for the reason that there was offered to them no dependable mixer

THE JAEGER *Big-an-Litle concrete mixer for sidewalk, curb and gutter work.*

for doing this particular class of work. The result of this hand-mixed concrete has been that many inferior concrete walks have been laid. In all cities where specifications have been rewritten in the past year or two, they require that the concrete be mixed in a concrete batch mixer, subject to inspection of regularly appointed city inspectors.

In following such specifications, it is necessary to operate a power mixer, and the contractors at first were at a loss to know where to obtain a mixer suitable for this particular class of work, as the large batch mixers heretofore used were not adaptable, since they cost too much, are too clumsy and too costly to operate on sidewalk work, and the depreciation of value is too great. The Jaeger Machine Company, who have been building mixers, both large and small, for all purposes for the past nine years, were among the first to see these conditions and two years ago brought out a mixer for this specific purpose: a mixer that is dependable; a mixer that costs only a reasonable sum to buy; a mixer that is economical to operate; a mixer that was not an experiment, but the result of seven years' experience and practical development. Its low cost, light weight and durability, together with the capacity of at least 1,500 square feet of walk per day, including the top coat, were just what the contractors were looking for, and consequently hundreds of them are used for sidewalk work. Dozens of them have been sold to municipalities who put in their own sidewalks, curbs and gutters, as well as to other municipal departments, such as waterworks, fire departments, electric works and others. Hundreds are in use by all sorts of contractors on public work, as well as private contractors, and they enjoy a hearty recommendation by inspectors and engineers.

It is not necessary to purchase a large mixer in order to have a really dependable one, as the "Big-and-Little" mixer is a real mixer in every way, with great strength and durability, and operated at the lowest possible expense. Furthermore, this mixer is sold on a one-price basis to all, and a low one that will enable the big contractor to purchase many of them and the small contractor to purchase one, instead of using an old-time mixing board.

These mixers are working everywhere. Stop and inspect the next one seen and write for full particulars. Get in touch with the manufacturers, the Jaeger Machine Company, Columbus, O.

PLACING REINFORCEMENT *in concrete street pavement. Note case with which two men unroll and lay the sheet of reinforcing metal.*

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Reinforced Concrete Street Paving

The use of a sheet of reinforcing metal in concrete pavements is becoming more popular as its action in preventing the spread of cracks in the concrete from temperature changes, frost or flood damage is understood. Highland Park, Mich., of which W. H. Beckley is engineer, has used this construction as shown in the accompanying photographs.

The specifications provide for a 5-inch concrete base of proportions 1 cement, 2½ sand and 5 crushed hard rock, and a wearing surface of 1 cement, 1 sand and 2 hard rock or granite screenings.

As shown in the first photographs, the sheet of reinforcing metal is laid on the surface of the base, in which it is embedded as shown in the second photograph. And the wearing surface is then laid and formed by a template as shown in the same view.

Meyer and Labadie, the contractors on the street chose No. 8 rib metal of the Trussed Concrete Steel Company from among the materials admitted by the specifications "feeling that the greater ease of installation and the very superior reinforcement provided in rib metal justified paying the difference in the original cost price." They estimate the cost of laying rib metal at not more than one cent a square yard, practically the whole expense being the hauling of the material from the cars to the joh, since the sheets are shipped from the shop ready to lay in the pavement. The ease of placing is seen from the photographs, also the facts that no pegging or stretching is neces-

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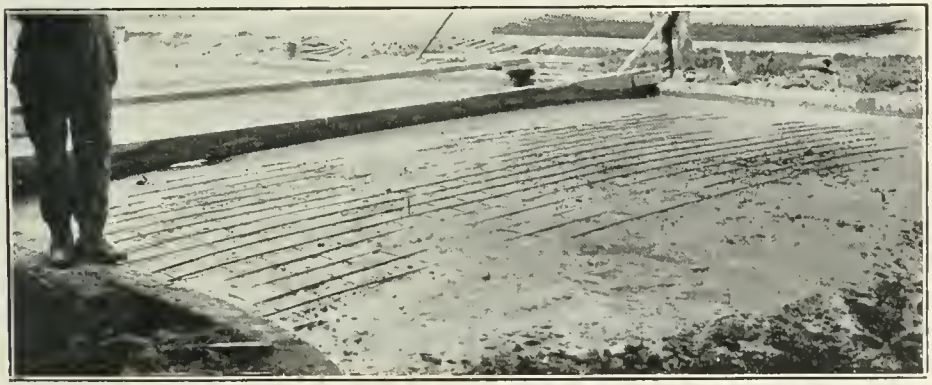
REINFORCING METAL *in place in concrete pavement on lower layer; workmen are placing the wearing surface over both.*



sary and that there are no kinks to straighten out.

The third photograph shows the method of placing armor plates for expansion joints at the street intersections. Two plates with sheets of elastic paving joint material between form each joint. The anchors to bind the armor plates to the concrete are seen in the photograph, which shows also the arching of the plates to fit the crown of the street and the pegging into place, the pegs being removed as the concrete is placed.

It will be noted that the joints form a rectangle with sides about on the lines of the curb of the two streets. From each corner of this rectangle a short joint of the same kind runs over to the curb, since the rounding of the curb corners leaves a distance of some feet between the circle of the curb and the intersection of the general lines of the curbs. This makes one block of the center of the street intersection and one block of each wing of the intersection of the side street, leaving the regular blocking by expansion joints of the street under construction undisturbed.

The street intersections are troublesome places to take care of in brick, wood, concrete or like expansible materials, because the change in crown caused by the entrance of the intersecting street introduces a change in the direction of resistance to the temperature stresses and thus makes it possible for expansion of the surface of the pavement to cause the elevation of that surface at the weakest point, which is likely to be at the center of the intersecting street. This is shown in the picture of the explosion of a brick street at a street intersection, printed in the July number of MUNICIPAL ENGINEERING.

Making a single slab of the street intersection and protecting it with expansion joints on all four sides reduces the danger of trouble very materially, especially if the reinforcing metal sheet is used to take the tensile strains arising from the tendency of the intersection slab to buckle.

These armor plates for expansion joints are made by the Trussed Concrete Steel Co., of Youngstown, O.

PLACING *Trus-Con expansion joints at a street intersection. Note the rectangular block thus formed in the intersection and the short joint from the corner of that block to the rounded curb corner.*

Ingenious Water Cooling System

During the summer months especially, the problem of securing suitable drinking water is one that faces every factory manager.

That temperature is an important consideration is shown by the interesting experiments of Dr. Thomas Darlington, secretary of the Welfare Committee of the American Iron and Steel Institute. He found that the range of temperature at which water is palatable is extremely limited. Water is most enjoyable when at 50 to 55 degrees Fahr. At this temperature it has a stimulating action on the heart, and relieves fatigue and exhaustion, by equalizing the temperature of the body.

Water which is warm is insipid and uninviting. Water which is very cold, it is well known, is liable to cause violent illness, such as cramps, prostration, etc. Absences and inefficiency, particularly during the summer, have been definitely traced in many cases to the lack of a proper drinking water supply.

A unique system for properly cooling and distributing drinking water, known as the J-M system, is now being extensively adopted by many manufacturing concerns of national prominence.

The water is cooled to the right temperature by the A-S refrigerating machine and is then piped to bubbler fountains placed at advantageous locations thruout the plant.

The A-S refrigerating machine is entirely different from any other. The refrigerating vapor is sulphur dioxide. The very offensive and corrosive gases usually used are done away with. The working mechanism is entirely enclosed and sealed. Practically no attention is necessary as the machine operates for years without refilling, adjustments or repairs.

To run this machine it is merely necessary to throw on a switch. To stop it, pull the switch. A thermostat connection is arranged to start and stop the machine at certain temperature limits, thus automatically keeping the water at a uniform temperature all the time.

The bubbler fountains used with J-M systems are carefully designed to permit the flow of an ample, satisfying stream without waste.

This system, besides having the distinct advantage of providing a proper water supply, eliminates the disadvantages connected with the use of ice. It makes the plant manager independent of uncertainties in the ice supply. It does away with the disease-spreading possibilities of the common cup and polluted ice. It discourages the habit of congregating around the drinking place and wasting time. In many cases, it is said, the J-M system shows an actual economy over the ice-cooled method.

An interesting booklet describing this system in detail has been issued by the H. W. Johns-Manville Co., N. Y.

Motor Omnibuses in Boro of Queens, New York

The Hillside Transportation Company having asked for a franchise to operate motor omnibuses on five routes aggregating about 18 miles in the Boro of Queens, New York City, the Board of Estimate and Appointment has passed a resolution permitting the operation of a part of the routes for an indefinite period of time, not exceeding one year, so that data can be obtained on which to base terms for a franchise, there being nothing available at present on which to formulate such a franchise. The company is to pay 5 per cent. of the gross receipts from the operation of the lines, not less than $15 per month per mile of line operated. This payment seems to be considered as payment for damage to streets, cost to city on account of the operations of the company, and the like. No maximum rate of fare is proposed, but it is understood that it is the intention to charge 10 cents for the full length of line and 5 cents for short rides between. The question of fares is one on which there is not enough information and a year's operation will give some.

The lines do not compete with existing street car lines and in that respect are in better condition than the lines in Indianapolis which were obliged to reduce their fares from 10 cents to 21 tickets for $1, and later to 5 cent fare with 25 tickets for $1, the same as the street cars. It is understood that at these latter rates the company was able to pay operating expenses but could not make proper provision for replacement of stages as they wore out, so that it was obliged to quit business.

The New York company will begin business with four stages, to be increased to six, and the success of the operation as well as the effect on the streets and roads will be awaited with interest.

London motor omnibuses are reported to be very severe upon the streets over which they run.

Trade Publications

The Marsh-Capron Mfg. Co., Old Colony Bldg., Chicago, Ill., has issued catalog No. 30 regarding M-C rail-track mixers for concrete, whose motto is "Most Mixing, Least Fixing." The mixer is also used in plants manufacturing glass and fertilizers and in zinc works and foundries.

The Harris Patents Co., New York, is-

sues a series of circulars on the Harris valveless Diesel engine, entitled "From Stone Cold to Full Power in Ten Seconds."

The St. Louis Distributer of oil and tar over roads and pavements is illustrated in a circular issued under the above title from 612 National Bank Bldg., by J. C. Travilla, W. L. Hempelmann, and O. S. Brighton.

The Kissel-Kar in Contractors' Work

The accompanying photograph shows a three-ton Kissel truck operated by the track construction department of the Los Angeles Railroad Company hauling a contractors office building, indicating the varied uses to which it can be put. Note the method of holding the building in place on the truck by means of ropes and stakes.

The Seebee Dryer

The illustration on page 170 of the Seebee dryer is of interest to every up-to-date asphalt paving man. The unique feature of the Seebee dryer is "Two Dryers in One."

The flue-jacketed inner drying cylinder and the hollow cascading blades shown in cut double the heating and drying capacity without shortening the life of the dryer by forcing it.

When the material is fed into the Seebee dryer it is immediately distributed over a large area of heating surface, part of the material going into the inner drying cylinder and the other part going into the outer dryer cylinder, so that the material flows and cascades around the heated inside surface of the outer dryer cylinder as well as around both the heated inside and outside surfaces of the inner drying cylinder. So, by adding the inner cylinder the material comes into contact with greately increased area of heating surface over what could be obtained without the inner cylinder and the moisture in the material is quickly vaporized in consequence.

Then as the material travels through the rear portion of the cylinder it is divided into separate masses by the perforated diaphragm plates which divide the cylinder into longitudinal compartments. The hot air from the furnace is drawn thru the hollow lifting blades and thru the masses of material rolling and cascading over the blades, then the hot air ascends thru the perforations in the diaphragm plates thru the material which is being cascaded across the diaphragm plates, so as to ensure a perfect commingling of the heated air with the material as it travels thru the cylinder.

The inventor of the Seebee dryer, Mr. C. B. Smith of Cleveland, Ohio, has had many years' experience designing and building dryers and asphalt paving plants. His firm address is C. B. Smith & Co., 411-412 Prospect-Hippodrome Bldg., Cleveland, Ohio.

Tarvia

Preserves Roads
Prevents Dust

Mandell Estate,
Hamilton, Mass.
Tarvia-macadam.

Dust costs money—

DUSTY roads are expensive, for the presence of dust means that costly road material is being cast away to the four winds of heaven. Sooner or later it must be replaced at great expense.

Ordinary waterbound macadam is not sufficiently bonded to resist modern traffic. A stronger binder is needed. That is why modern engineers are turning to Tarvia—a coal tar product of great adhesive power, which is used to cement the stone together.

Under heavy loads a tarviated road is somewhat elastic—not brittle—and traffic wears it smoother. The Tarvia also has the effect of making the road surface waterproof and preventing ravelling by rain torrents.

The addition of Tarvia to the macadam costs so little that it is more than balanced by the saving in maintenance expense. The road instead of being torn up by traffic and blown away by the winds, stays where it is put and the annual repair bill is reduced materially.

Progressive engineers in hundreds of towns are using Tarvia regularly.

Tarvia is made in three grades: "Tarvia X" for new or rebuilt roads and pavements, "Tarvia A" for surface application, and "Tarvia B" for dust prevention and road preservation.

Tarvia booklets on request. Address our nearest office

BARRETT MANUFACTURING COMPANY

New York Chicago Philadelphia Boston St. Louis Cleveland Cincinnati
Pittsburgh Birmingham Kansas City Minneapolis Seattle
THE PATERSON MFG. CO., Limited: Montreal, Toronto, Winnipeg, Vancouver,
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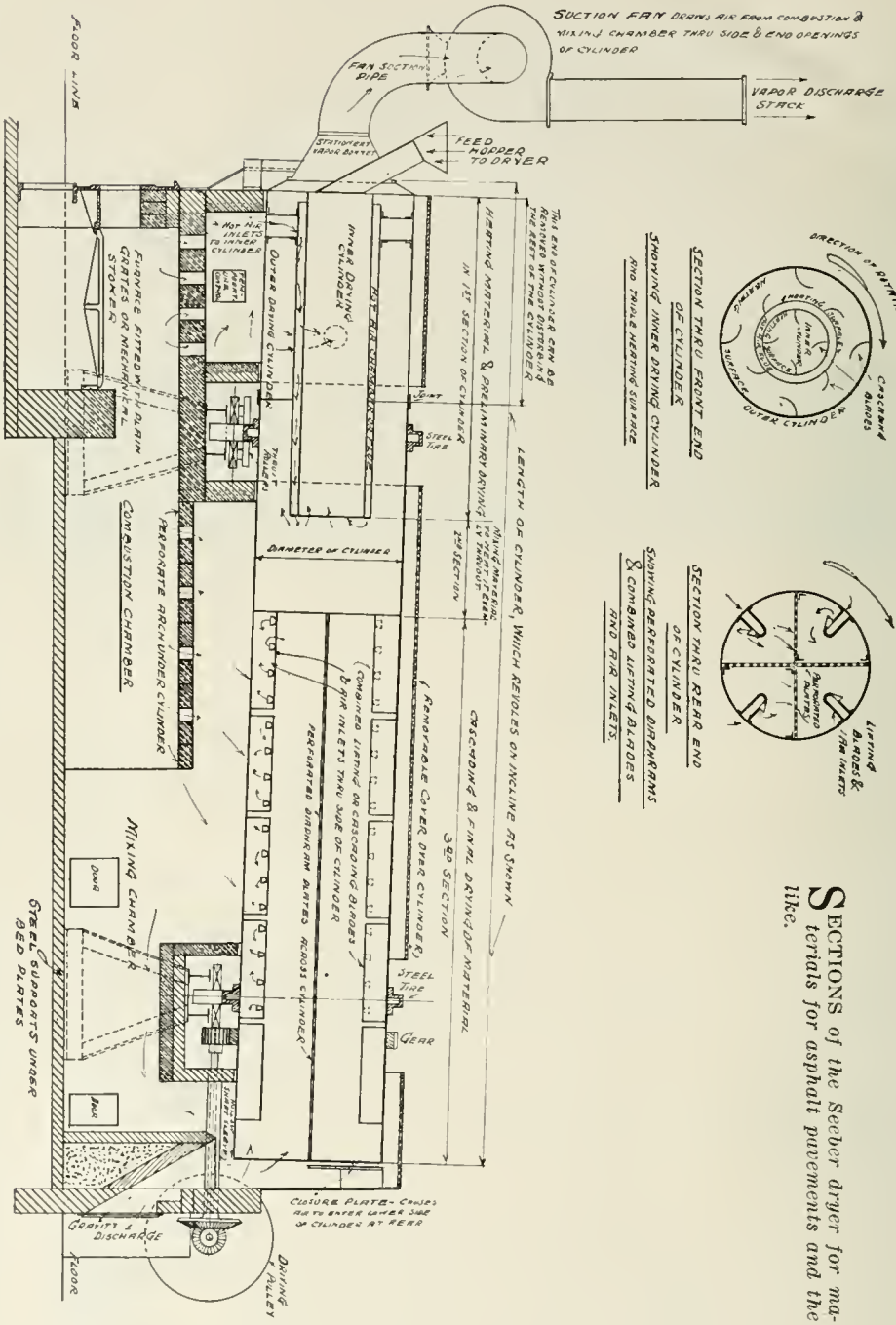
TRADE B MARK


SUCTION FAN DRAWS AIR FROM COMBUSTION & MIXING CHAMBER THRU SIDE & END OPENINGS OF CYLINDER
VAPOR DISCHARGE STACK
FAN SUCTION PIPE
STATIONERY VAPOR BONNET
FEED HOPPER TO DRYER
FLOOR LINE
HOT AIR INLETS TO INNER CYLINDER
OUTER DRYING CYLINDER
INNER DRYING CYLINDER
HOT AIR UNDER OUTER CYLINDER
TRUNNION PULLEY
JOINT
STEEL TIRE
HEATING MATERIAL & PREHEATING IN 1ST SECTION OF CYLINDER
MIXING MATERIAL & PREHEATING IN 2ND SECTION
LENGTH OF CYLINDER, WHICH REVOLVES ON INCLINE AS SHOWN
DIAMETER OF CYLINDER
CASCADING & FINAL DRYING OF MATERIAL
3RD SECTION
REMOVABLE CUTER OVER CYLINDER
(COMBINED LIFTING OR CASCADING BLADES & AIR INLETS THRU SIDE OF CYLINDER)
PERFORATED DIAPHRAM PLATES ACROSS CYLINDER
STEEL TIRE
GEAR
CLOSURE PLATE - CAUSES MATS ENTER WHERE SIDE OF CYLINDER AT REAR
GRAVITY DISCHARGE
FLOOR
DRIVING PULLEY
FURNACE FITTED WITH DUMP GRATES OR MECHANICAL STOKER
COMBUSTION CHAMBER
PERFORATE ARCH UNDER CYLINDER
MIXING CHAMBER
DOOR
DOOR
STEEL SUPPORTS UNDER BED PLATES
THE END OF CYLINDER CAN BE REMOVED FOR REPAIRS AND THE REST OF THE CYLINDER
SECTION THRU FRONT END OF CYLINDER
SHOWING INNER DRYING CYLINDER AND TRIPLE HEATING SURFACE
DIRECTION OF ROTATION
CASCADING BLADES
HEATING SURFACE
INNER CYLINDER
OUTER CYLINDER
SECTION THRU REAR END OF CYLINDER
SHOWING PERFORATED DIAPHRAMS & COMBINED LIFTING BLADES AND AIR INLETS
PERFORATED PLATES
LIFTING BLADES & AIR INLETS

SECTIONS of the Seeber dryer for materials for asphalt pavements and the like.

SAFETY FIRST

Pave your streets with **BITULITHIC,** the pavement which is made of varying sizes of the best stone obtainable combined with bituminous cement and laid under close laboratory supervision and have a pavement which is safe in wet and dry weather, thus preventing accidents from skidding automobiles and falling horses.

Modern traffic demands the highest type of construction on your streets, and low prices usually mean low value and lack of lasting qualities.

West Dominick Street, Rome, N. Y., looking west from the Wood Creek Bridge, 3,600 feet. This street, before being improved, was the worst roadway in Oneida County.

When you want Bituminous pavements, specify more than merely Bituminous Concrete; **Specify Bitulithic** and get tested and guaranteed quality which has proved to be the "Best by Every Test."

If **Bitulithic** is once adopted for your streets, you will always insist on it.

Additional large contracts are constantly being awarded by cities that have used it for many years.

Bitulithic is the answer to the question of "Economy of Street Pavements."

If your streets are paved with **Bitulithic,** the attractiveness of your city to visitors as a place of residence will be increased, and will directly result in a growth of population. Automobilists constantly travelling over **Bitulithic** streets carry its praise everywhere.

Specify **Bitulithic** and have a pavement which is

Unequalled in reputation. **Unquestioned** in quality. **Unrivalled** in popularity.

EVERYTHING TO GAIN — NOTHING TO LOSE.

Why not pave your streets now with **Bitulithic?** Write today for explanatory booklets and learn more about this modern pavement for modern cities.

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606 First National Bank Bldg.	Virginia Railway & Power Bldg.	Railway Exchange Bldg.

CONTRACTING NEWS

AUTOMOBILES.

FIRE APPARATUS.

Asheville, N. C.—Purchase of automobile hook and ladder wagon recommended by Board of Aldermen. A. G. Barnett, chairman Fire Committee.

Bloomfield, N. J.—All bids for supplying Essex hook and ladder company with automobile fire apparatus rejected. Will readvertise at once. William Hauser, mayor.

Deming, N. Mex.—Purchase of combination chemical and auxiliary fire engine to cost about $8,000, contemplated. Address Board of Trustees.

Indianapolis, Ind.—Bond issue of $100,000 authorized by Board of Safety; $30,000 to be used in construction of two fire engine houses and remaining $70,000 to be used in buying motor equipment for same; board also contemplates buying combination motor hose and ladder truck for Ashland avenue engine house, combination motor hose and pump for engine house No. 13 and motor tractors for water tower and aerial truck at engine house No. 12. J. Harry Johnson, fire chief.

Knoxville, Tenn.—Bids will be asked at once for motor-driven patrol wagon and chemical fire engine. James A. Hensley, commissioner of public safety and recorder.

Jamestown, N. Y.—Purchase of combination fire engine, hose wagon auto truck voted by Common Council. Samuel A. Carlson, mayor.

Paris, Tenn.—Purchase of auto fire truck ordered by City Council. J. M. Freeman, mayor.

Pontiac, Mich.—Only one bid received for auto for fire chief, that being submitted by Frank S. Milward of local Ford agency. Bid $539 for runabout of special design. Bid referred to Mayor A. J. Johnson.

Toledo, Ohio—Bond issue of $32,942 authorized by Board of Control for purchase of five Peerless hook and ladder trucks at $22,250 and for two Seagrave service trucks at $5,346 each.

BRIDGES.

BIDS REQUESTED.

Athens, Ohio—Aug. 15th, until 10 a. m., for superstructure for bridge over Federal Creek, in Rome Township, Athens County. Length, 114 feet; width of roadway, 12 feet. Certified check $200. Address Board of County Commissioners.

Bowman, Ga.—Until Aug. 24th for steel bridge near this city, consisting of three spans 80 feet, 120 feet and 160 feet, and four reinforced concrete piers and two abutments. Plans on file with good roads department, University of Georgia, Athens.

Chicago, Ill.—Aug. 5th until 11 a. m., for substructure of double-leaf trunnion bascule bridge over north branch of Chicago River at Belmont avenue—clear span between masonry 161 feet 3 inches. Width of bridge, 60 feet; cylinder and pile foundations. Certified check $300. L. E. McGann, commissioner of public works.

Chicago, Ill.—Aug. 7th, until 11 a. m., for superstructure of double-leaf trunion bascule bridge at Belmont avenue. Certified check $3,000, made payable to L. E. McGann, commissioner of public works.

Hillsboro, Ill.—(Change of date)—Until Aug. 8th for construction of Tremont street bridge, this city, work to be completed by Nov. 15, 1914. A. N. Johnson, chief state highway engineer.

Lebanon, Ind.—Aug. 12th until 1 p. m. for eight bridges and repair of one bridge in Boone County. D. M. Clark, auditor.

New Philadelphia, Ohio—Aug. 17th until 1 p. m. for steel superstructure, 77 feet long and 15 feet roadway, and repair of abutments of bridge across Sugar Creek. Certified check $200. R. H. Nussdorfer, auditor Tuscarawas County.

Shelbyville, Ind.—Aug. 8th until 10 a. m. for four concrete culverts in Shelby County.

Toledo, Ohio—Aug. 21st until 10 a. m. for Frank W. Fagel, auditor.
construction of culverts in Lucas County. Certified check 20 per cent. of bid. Chas. J. Sanzenbacher, county auditor.

Warren, Ohio—Aug. 10th until 1 p. m. for substructure for Idylwild bridge over Yankee run, Brookfield Township. W. R. Herrington, auditor Trumbull County.

Youngstown, Ohio—Until Aug. 7th for concrete bridge across Andrews Hollow at Fifth avenue; length 500 feet; width 75 feet. F. M. Lillie, city engineer.

Zanesville, Ohio—Aug. 10th until 1 p. m. for building additional heighth on two abutments and one pier and protecting footings of piers and raising bridge near Adams Mills, Ohio. Certified check 10 per cent. of bid. Fred C. Werner, Clerk Muskingum County commissioners.

CONTRACTS AWARDED.

Kokomo, Ind.—To National Concrete Company, Indianapolis, and to Burke Construction Company, Newcastle, Ind., Howard County bridges, at $6,300 and $8,349, respectively.

Parkersburg, W. Va.—To Herman Laub, Pittsburg, Belpre bridge across Ohio River. Contract price $438,000.

Tacoma, Wash.—To McCreary & Williard, Spokane, steel superstructure for bridge in this city, and to Widell Co., Mankato, Minn., substructure for same. Total cost $250,000.

CONTEMPLATED WORK.

Chico, Cal.—Bids will be asked shortly for steel and reinforced concrete bridge over Big Chico creek. M. C. Polk, Chico, Butte County surveyor.

Indianapolis, Ind.—Plans about completed for bridge over White River at West New York street. Appropriation, $150,000. W. T. Patton, county auditor.

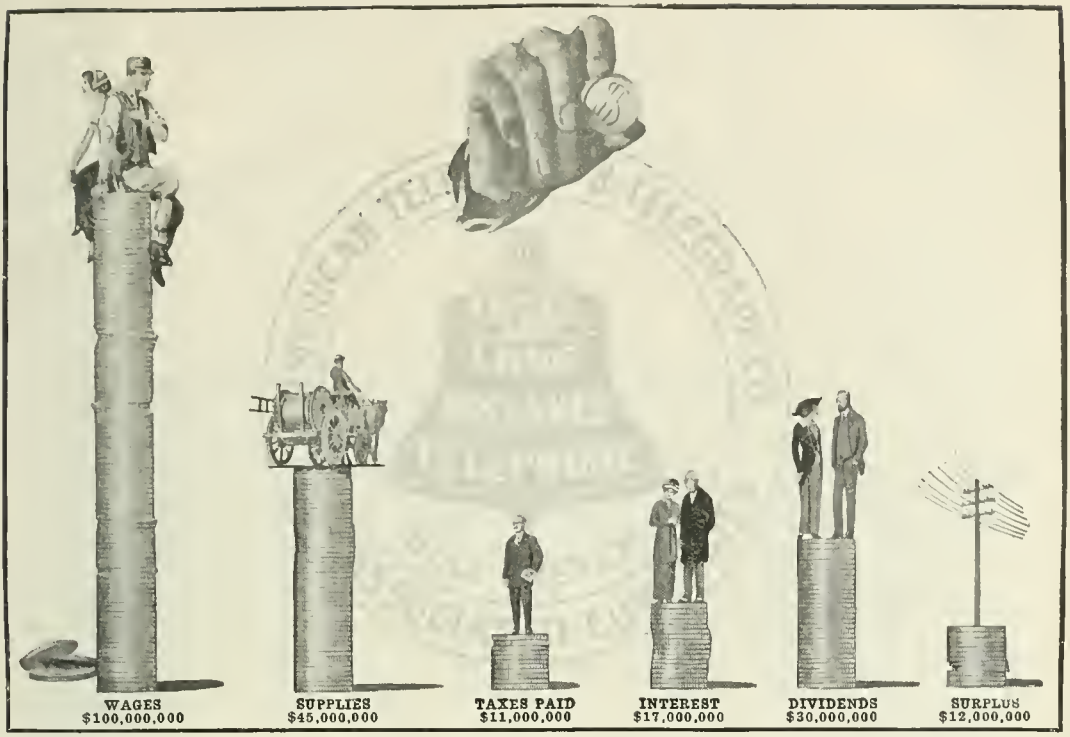
Fort Lauderdale, Fla.—Steel rolling lift bridge over New River, this city, planned by county commissioners Estimated cost, $15,000. Address Dade County commissioners, Miami, Fla.

Little Rock, Ark.—Construction of bridge across Arkansas River at Broadway. Estimated cost $470,000. H. Levinson, city engineer.

Lynchburg, Va.—Plans for proposed viaduct over James River from Seventh to Commerce streets approved by City Council. Ernest Williams, president Chamber of Commerce

Oswego, N. Y.—Four separate plans for bridge at Minetto over Oswego River are being considered by commissioners.

Seattle, Wash.—Bond issue voted for constructing a bridge at Fifteenth avenue over Lake Washington Canal and one at Fremont. Estimated costs, $479,500 and $350,000, respectively. A. H. Dimock, city engineer.



How the Bell System Spends its Money

Every subscriber's telephone represents an actual investment averaging $153, and the gross average revenue is $41.75. The total revenue is distributed as follows:

Employes—$100,000,000

Nearly half the total—$100,000,000—paid in wages to more than one hundred thousand employes engaged in giving to the public the best and the cheapest telephone service in the world.

For Supplies—$45,000,000

Paid to merchants, supply dealers and others for materials and apparatus, and for rent, light, heat, traveling, etc.

Tax Collector—$11,000,000

Taxes of more than $11,000,000 are paid to the Federal, state and local authorities. The people derive the benefit in better highways, schools and the like.

Bondholders—$17,000,000

Paid in interest to thousands of men and women, savings banks, insurance companies and other institutions owning bonds and notes.

Stockholders—$30,000,000

70,000 stockholders, about half of whom are women, receive $30,000,000.

(These payments to stockholders and bondholders who have put their savings into the telephone business represent 6.05% on the investment.)

Surplus—$12,000,000

This is invested in telephone plant and equipment, to furnish and keep telephone service always up to the Bell standard.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY

AND ASSOCIATED COMPANIES

One Policy *One System* *Universal Service*

BUILDINGS.

BIDS REQUESTED.

Cheltenham, Pa.—Until Aug. 5, for erection including heating, plumbing and electrical work, of school in this city. Herbert C. Wise, architect, 133 South Twelfth street, Philadelphia.

Chicago, Ill.—Aug. 6, until 11 a. m., for two Ward bldgs. and one connecting corridor, to be erected at S. California Ave. and W. 31st St., Contagious Disease Hospital. Certified check $15,000, payable to L. E. McGann, Commissioner of Public Works.

Cincinnati, Ohio.—Sept. 1, until noon, for court house and county jail. Certified check $250 required for each branch of work. Jas. A. Greene, Pres. New Court House Bld. Com.

Columbus, Ohio.—Until Aug. 10, for Studer Ave. school building. D. Riebel, Arch., New First National Bank Buildnig.

Detroit, Mich.—Aug. 10, until 2:30 p. m., for erecting engine house on Coplin Ave. Geo. J. Finn, Secy. Fire Com.

Greencastle, Ind.—Aug. 8, until 2 p. m., for school house in district No. 3 in Fillmore, Marion Township, Putnam County. Otto B. Rector, Trustee.

Marion, Ohio.—Aug. 17, until noon, for reconstructing Olney Ave. school building. Allan & Hall, Arch., Columbus, Ohio. Jeanette L. Hutchinson, clerk Board of Education.

Stilesville, Ind.—Aug. 7, until 10 a. m., for school house in district No. 5, Franklin Township, Hendricks County. T. R. Ruark, Trustee.

Whitestown, Ind.—Aug 7, until 1 p. m., for high school building for Worth school township, Boone County. Seymour R. Stewart, Trustee.

Waukegan, Ill.—Bids will be asked shortly for construction of county hospital. Estimated cost $13,000. C. W. Webster, Arch.

Worcester, Mass.—Appropriation of $33,500 for four room addition to West Boylston St. School and $62,000 for 8-room addition to Harlow St. School, approved by city council. Geo. C. Holcott, Supt. of Bldgs.

LIGHTING.

Estherville, Emmet Co., Iowa.—Aug. 11, until 9 a. m., bids will be received for additions to electric light plant as follows: Improvements to brick tower station, radial brick or reinforced concrete stack 150-ft. high by 5-ft. inside diameter, industrial trolley coal car, 300-h.p. boiler, installation, ffurnishing and setting mechanical stokers, 400 h.p. engine; generators, switchboard, remodeling pole line and wiring system. Bond, 20 per cent. bid. N. B. Egbert, City Clerk. J. F. Gruar, Consulting Engineer, Commercial Bldg., St. Paul, Minn.

Huntington, Ind.—Bond issue of $50,000 for municipal light plant voted by city council. M. McCarty, Mayor.

Pattonburg, Mo.—Electric light plant contemplated. Bond issue $10,000.

Quitman, Ga.—Enlargement and improvement of municipal electric light plant. Bond issue for $40,000 being considered. A. W. Voight, City Clerk.

Santa Ana, Cal.—Preliminary plans being arranged by Board of Co Supervisors for boulevard lighting project by which all boulevards now being made in Orange Co., running from sea to mountains and from Los Angeles Co. to San Diego Co., will be lighted.

Sacramento, Cal.—Two lighting districts, one on M. St. and one on Maple Ave., proposed. G. Stanley Pearce, City Electrician.

Spencerville, Ohio.—Bond issue of $10,000 voted for reconstruction of municipal electric light plant. John W. Berry, Village Clerk.

ROADS AND PAVEMENTS.

BIDS REQUESTED.

Clarksville, Tenn.—Aug. 7, until noon, for 65,000 cu. yds. excavation and 10,000 cu. yds. macadam surfacing. D. T. Foust, Co. Rd. Engr.

Ft. Stockton, Tex.—Aug. 13, until 1 p. m., for 250 miles of Pecos Co. highways. Separate bids will be received for concrete work. Howell Johnson, Co. Judge, Fort Stockton, Tex.

Greencastle, Ind.—Aug. 12, for about 20,974 ft. of macadam road improvement in Greencastle Twp., Putnam Co. C. L. Airhart, Aud.

Harrisonville, Wis.—Until Aug. 7, for 5,445 sq. yds. brick pavement on 5-in. concrete base, sand cushion 1½-in.; also about 600 ft. concrete curb and 934 cu. yds. excavation. Estimated cost $10,000. Geo. Bird, City Engr.

Miami, Fla.—About Aug. 6, for 95,000 sq. yds. asphaltic concrete, vitrified brick, bitulithic, creosoted wood block and asphaltic block pavements. B. F. Klyce, Eng.

Sacramento, Cal.—Until Aug. 10th, for 69.9 miles state highway construction in ten counties. Austin B. Fletcher, state highway engineer.

Tampa, Fla.—Aug. 6th until 10 a. m. for following road construction: Tampa-Plant City road, 128,000 square yards brick pavement, No. 1 brick, width 15 feet, 154,294 lineal feet granite curb; Harvey-Thonotosassa road, 46,500 square yards brick, 93,000 lineal feet wood curb; River View road, 52,800 square yards brick pavement, 105,600 lineal feet wood curb; Port Tampa road, 25,000 square yards brick pavement, 30,100 lineal feet wood curb. Certified check 1 per cent. of bid. James Riddle, road engineer, Hillsborough, Ga.

CONTRACTS AWARDED.

Austinburg, Ohio—To B. F. Hewit, Austinburg, 2.48 miles of concrete road at $18,701.91.

Beardstown, Ill.—To Beardstown Concrete Construction Co., city, one mile cement road south of town at $4,500.

Belleville, Ill.—To Hoeffken Bros., city, paving of Silver street at $7,695.27.

Bellingham, Wash.—To G. C. Burnett, Bellingham, asphalt paving in business district at $74,000.

Cameron, Tex.—To Howard & Taylor, of Bell County, roads in Road District No. 2 at $71,605.

Canal Dover, Ohio.—To Cross & Meyer, Wheeling, paving on Second street, Iron avenue and Slingluff avenue at $44,240.16.

Corning, N. Y.—To Bradley & Nolan, city, brick paving on Market street at $39,943.88.

Duluth, Minn.—To A. N. Nelson, city, paving at Victoria street. Bid one course concrete $9,336.65; two course concrete $9,509.65; silica concrete, $11,661.33.

Harrisburg, Pa.—To Northwestern Construction Co., Franklin, Pa., extension of Sugar Creek road at $12,991.70; to B. H. Corvell, Williamsport, Pa., about one mile brick block paving on Depot street and Front street at $27,821.

Hurley, Wis.—To Fred Eul, Neenah, Wis., brick paving on Silver street at $32,197.

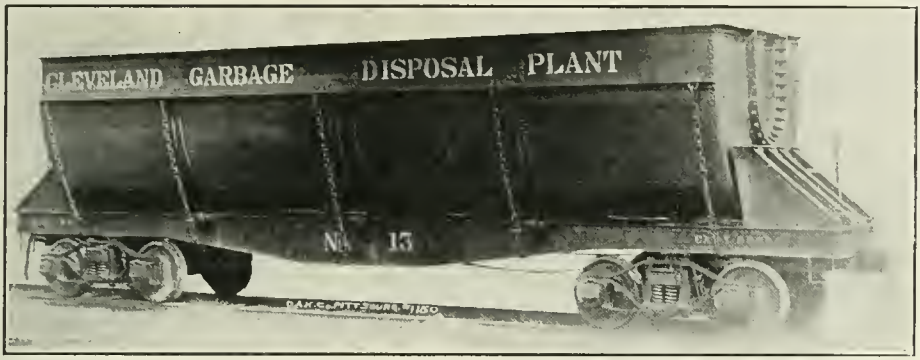
Marysville, Ohio.—To John M. Snouffer, 4.34 miles, Marysville-Columbus road, waterbound macadam at $37,000.

New Ulm, Minn.—To Fielding & Shepley, St. Paul, 15,203 square yards of paving, including curb and catch basins, at $37,067.

Rockford, Ill.—To A. E. Rutledge, city, brick paving on South Main street at $31,286.61.

MUNICIPAL ENGINEERING

The World's Leading Municipal Publication.



CAR FOR TRANSPORTING GARBAGE FROM THE CITY LOADING STATION TO CLEVELAND'S MUNICIPAL GARBAGE REDUCTION PLANT.

Vol. XLVII. SEPTEMBER, 1914. No. 3.

"If one has but five minutes in which to perform a task, three minutes should be consumed in ascertaining how to do it."

Published by

Engineering Publishing Co.
INDIANAPOLIS, IND.

New York Office:
1127 World Bldg.
GEO. H. CLINGAN,
Eastern Mgr.

Entered at Postoffice, Indianapolis, as Second-Class Matter.

Chicago Office:
1634 Marquette Bldg.
E. D. POWELL,
Western Mgr.

A. P. Fox, President. **C. C. Brown, Editor.** **C. S. Sale, Gen'l Mgr.**

Subscription Price in U. S. and Possessions, Cuba and Mexico, $2.00. Canada, $2.40. Foreign, $2.75.

Changes of address, subscriptions, remittances and editorial matter should be addressed to MUNICIPAL ENGINEERING, Indianapolis, Ind.

STREET CLEANING
METHODS AND RESULTS

By Edward D. Very, Sanitary Engineer, Battery Place, New York City.

Experience for a number of years in the street cleaning departments of New York fits the author to discuss his subject in a manner to attract the attention of the many city officials who are intensely interested in it and who are looking for some one who can be depended upon to give valuable and unbiased advice and information He will follow this article with others upon particular parts of the subject if inquiries for further or more detailed discussion are received. The pictures are selected by the editor to illustrate the development sketched by the author and the types of machines mentioned, some of them being reproduced from earlier volumes of MUNICIPAL ENGINEERING.

THE items considered in choice of pavement are: first cost, ease of traction, non-slipperiness, ease of cleaning, noiselessness, dustlessness and sanitariness.

Only very recently have ease of cleaning and sanitariness been included in these items. Tillson gives these items a value of 15 and 13, respectively, out of a total of 100 points. He then lists the pavements in order of their value as follows: For ease of cleaning, brick 15, asphalt, wood and bitulithic 14, and granite 10: For sanitariness, wood 13, asphalt and bitulithic 12, brick 10 and granite 9. Most men engaged in street cleaning will disagree with these values as regards wood pavements, as they are very hard to clean thoroly.

There are two adverse interests in a practical choice; the users who want pavement conducive to ease of traction, and the residents and pedestrians who want quiet and freedom from dust.

There are two general classes of street dirt, the natural and therefore unavoidable and that due to carelessness and therefore avoidable. In the first class are included soot and dust from the air, detritus from the wear of the pavements, vehicle tires and horses' shoes, excrement of animals, dirt and sand which works up thru the joints of pavements laid on earth or sand foundations and having sand or gravel joints, dirt brought in from adjacent dirt or macadam streets, and leaves from shade trees. In the second class are refuse swept from buildings and sidewalks, refuse thrown from buildings, refuse discarded by those using them, dirt dropped from overloaded or leaking vehicles, and debris from construction operations.

The removal of materials of the first class is the real duty of the street cleaner and his studies ought to be confined to the proper performance of that duty. The removal of the materials of the second class ought not to be necessary, but, even in the face of the existence of ordinances covering the prevention of every detail, the nuisance exists in every city and to a very large extent. The duty of prevention is really that of the police and health authorities.

In New York City careless littering is estimated to cause a loss of time on the part of the sweeper of about 20 per cent. in the Boro of Manhattan and of 10 per cent. in the other Boros. Dr. Cronin says "a campaign of education should be instituted in the body politic to the end that they would understand that they are individually responsible that the cleanliness

THE MAN WITH THE BROOM *is the primitive type of street sweeper. This is a gang of white wings in Philadelphia.*

of the streets be maintained, and they as individuals will do nothing that will contribute to the disorder of the street, and where possible, prevent others from doing anything disorderly."

Some attempt has been made to formulate an estimate of the amount of materials which naturally accumulate upon a city street, but such an attempt is bound to fail, as the contributing elements vary in different localities in a city and in different cities. Where figures are given they do not really present any valuable data to the student. It is estimated that six tons of soot and dust fall upon a square mile of city during one month of winter. Again we are told that 1,000 horses will excrete 500 gallons of urine and 10 tons of dung during a working day of 8 hours. These figures may interest the student in the abstract but have no real value to the practical operator.

The only method of arriving at quantities is a study of the exact conditions on the spot and a continued study of the conditions as they change. The first study should be made by an expert, the other will naturally become a part of the duty of the supervisor of the work when in operation.

Most writers on street cleaning and street dust, lay emphasis upon the necessity of cleansing almost wholly upon the ground of the menace to health which lurks in street filth. Sanitarians vary widely on this point.

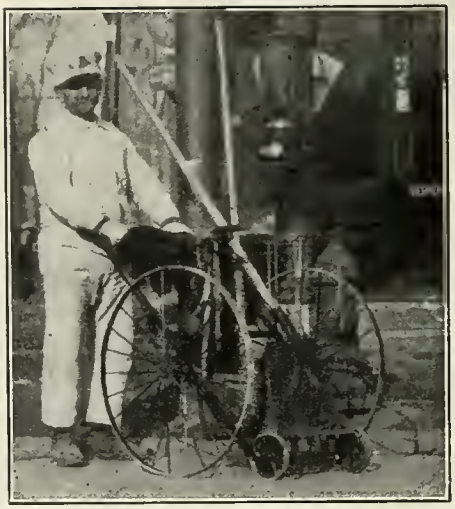
Dr. Soper says: "There is something incongruous about a board of health conducting a crusade against smoke and noise and at the same time allowing the streets to be filthy with dust and dirt." Prof. Gorham says: "The very processes which tend to produce dust are the very processes which destroy bacteria."

Dr. Hayes says: "The micro-organisms which appear in street dust are the bacilli of tuberculosis, many varieties of the colon bacilli, the bacillus aerogenes capsulatus, and the bacilli of tetanus, glanders, diptheria, anthrox, malignant edema, typhoid fever and epidemic dysentary. Dr. Soper says: "Most of the bacteria are probably of harmless saprophytic species."

Dr. Cronin says: "With perfect cleanliness sanitary science would be a lost art. Flies, mosquitoes, germs and bugs, all would be out of a job, and what a calamity to think of the numberless societies that would cease to exist."

The real reason, however, for cleaning streets should be the desire to be clean because of the great degree of comfort which is induced by cleanly conditions. One may do without a daily bath and still be fairly healthy, but one then loses the exhilaration and feeling of general well being and comfort experienced by the daily bather.

Streets in large cities today, besides being used as arteries for commercial traffic, have become the play grounds of the people. From the wealthy owner of the high-powered joy-car to the child of the tenement district playing his game, the street is the theatre of recreation. The automobile with its low body and quick movement is responsible for the extraordinary movement of dust and the infant



THIS STREET SWEEPER, *also in Philadelphia, has the full outfit necessary for the best and quickest work.*

in the baby carriage is the worst sufferer from its effects.

The items to be considered in a street cleaning system are: kind of pavement, condition of the pavement, amount and nature of traffic, street railway tracks, character of the neighborhood and character of the people in the neighborhood. Each has a distinct value and no formula can be presented, with so many values to be obtained, which will be easy of solution.

The elementary method of cleaning is the man with the broom. Not only must he be equipped with a push broom, but with a pan scraper, a squeegee, a shovel, cans and a can carrier; to which should be added a sprinkling can.

The broom is usually one which has a 4x18-inch block filled with split bamboo, rattan, hickory, steel wire or black African bass. The block usually is fitted with a steel scraper.

The pan scraper is constructed like a dust pan with turned up sides and back. It is about 38 inches wide by 15 inches deep.

The squeegee is a board about 30 inches wide, fitted with a rubber strip which extends below the lower edge of the board. Brooms, pan scrapers and squeegees have handles about 66 inches long.

The cans are made to hold about 3 cubic feet of dirt and taper from 19 inches in diameter at the top to 17 inches at the bottom, so that they may be nested for ease of carriage. The can carrier has two large wheels and two small, and has a platform upon which the can rests and a handle for propulsion.

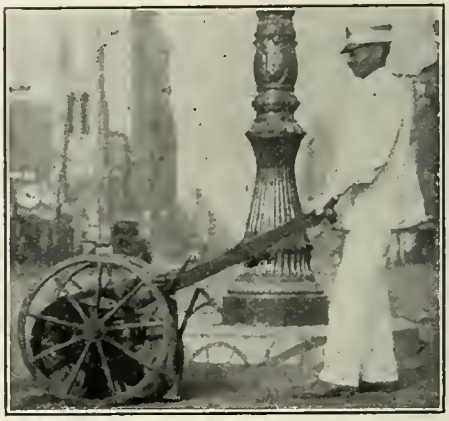
This method of cleaning is fairly effective but is a dust raiser, and the ability of the man to cover areas is very limited, especially at the present time, when the automobile has come into such general use that there is a constant parade which interferes with the sweeper in his work.

Many find fault with the broom because of the dust it raises, but there are hand machine brooms built on the principle of the carpet sweeper which are not dust raisers and which, as a matter of fact do much more effective work.

The pan scraper is only valuable to remove manure, mud and coarse litter and its use should be limited to the time necessary for such work and the broom used for dust removal.

A new can carrier has just been devised which carries two cans and is so balanced that the two cans are more easily manipulated than the one at present. This improvement is of considerable

THIS PHILADELPHIA WHITE WING *has the hand-machine sweeper mentioned by the author.*



AN EARLY STREET SWEEPING OUTFIT. *One broom to loosen the dirt and another to sweep it into windrows. No provision for preventing dust.*

value and will appeal to the street cleaning official as a great step ahead.

The area a sweeper can keep clean, of course, depends upon the existence of the adverse conditions named above. Waring tried a test in New York City, for one week, and found that the area one sweeper was able to keep clean, in a day of 8 hours, varied from 2,212 square yards to 15,075 square yards, with an average over the whole city of 5,745 square yards.

The efficiency division of the Civil Service Commission of Chicago in 1912 published a report which says: "From an analysis of the findings of time and motion studies of street cleauers, the following table has been deduced, upon

A MACHINE BROOM OUTFIT *with sprinkler and enough brooms to cover one-half the street.*

which are based a relative difficulty of cleaning different pavements under varying conditions, and the standards and equivalent areas to he cleaned by one man in one eight-hour day:

Pavement.	Condition of Pavement.	Sq. Yards.
Asphalt	Good	21,500
Asphalt	Fair	19,300
Asphalt	Bad	17,200
Creosote Block	Good	21,500
Brick	Good	16,000
Brick	Fair	14,400
Brick	Poor	12,800
Granite	Good	13,400
Granite	Fair	12,100
Grainte	Poor	10,700

I submit the figures without subscrib-

HAND BROOMS *in the gutter follow the gang of machine brooms.*

ing to them. There appears to be what Emerson calls "great discrepancy between actual results and reasonable standards."

To obtain the cleaning of larger areas in a given time, machine methods have been resorted to in the shape of horse-drawn brooms. These are rotary brooms mounted upon a frame and operated by a gearing to the axle. Their work is not as effective as that of the hand broom. The machine broom is preceded by a sprinkling cart to loosen the filth and in a measure to prevent the dust raising. This latter is seldom effected. Such a broom is found to cover about 40,000 square yards per 8-hour day. The materials swept are delivered in a windrow at the side and are finally delivered to a windrow in the gutter, from which they are picked up by the "white wing" with his shovel.

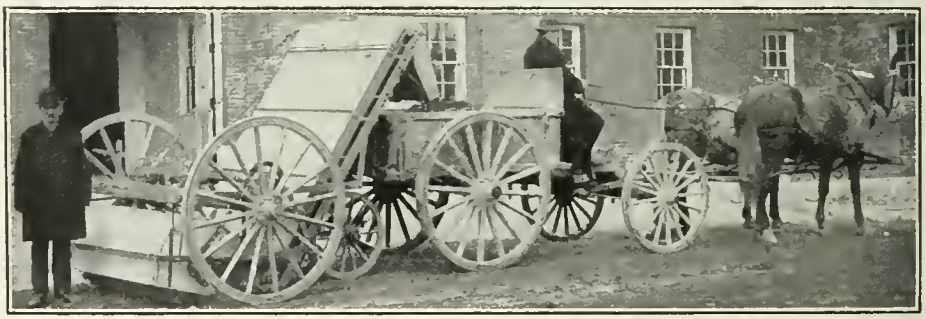
To improve on this method various types of "pick-up" sweeping machines have been invented and some built. Most of them have proved of no value. One upon which New York spent about $20,000 for testing, had many good points but weaknesses developed which were fatal, apparently thru lack of mechanical genius of the supervisors. A pick-up machine invented by a New York traffic-squad policeman has been tried out and found to be of value. It sweeps the dust upon a conveyor from which it is emptied into cans.

The principal defect in machine broom work is that the operation of sweeping depends upon the speed of traction of the vehicles. Thus particularly filthy spots do not receive special attention. If the work of the broom was independent of the traction, better results would undoubtedly be obtained.

Dr. Cronin says: "Dry sweeping is a barbarous, criminal procedure, but we can't get water to wet-sweep, so we move the dust from one spot to another and collect some of it. It is more criminal than street expectorating."

The present state of the art of vacuum cleaning has led many to endeavor to apply it to street cleaning operations and

A PICK-UP STREET SWEEPER *dropping sweepings into a detachable cart, each cart in turn hauling the sweeper until it has received its load and then detaching to carry load to dump.*



there seems no good reason to doubt the success of such application. But attention must be paid to the particular requirements and some difference in principle must be applied from that of the household cleaner. One such machine having a large intake and providing for a circulation of the air instead of its expression thru a filter, has been constructed and proven fairly effective.

The solution of the problem along these lines would meet with popular approval and at the same time should result in increased efficiency in street cleaning work. The problem, however, is not an elementary one and deserves the study of high class mechanical brains.

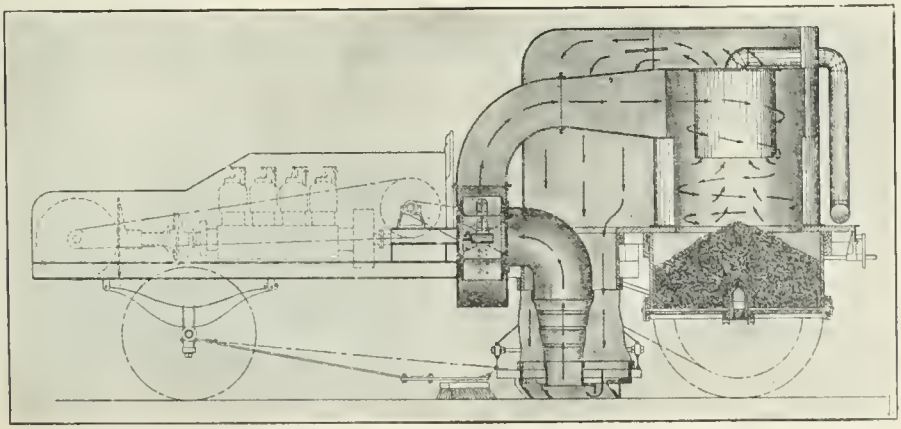
The vacuum machine will not pick up wet materials and probably need not, so time may be saved by not attempting to overcome this apparent difficulty.

It is an axiom that "rain is the street cleaner's best friend." During a rain storm the work of the "white wing" is much more effective than during dry weather. Water is as necessary for obtaining good results in street cleaning as it is in house cleaning and for practically the same reason. The use of a sprinkling cart alone is of no value, is a temporary makeshift and the result is nil.

Hose flushing is ineffective and uneconomical. The water does not reach the pavement in such a manner as to give full effect and usually is doing no work at all. Dr. Cronin says: "Four or five sweepers hold a hose and play it in some sections as tho their object were to wash away asphalt, block pavement and car tracks. Target shooting with a stream of water, so-called flushing, will never supplant wetting and scrubbing." Water to be effective must reach the pavement surface in a chisel shape and at the proper angle to loosen and carry off the filth. No man is properly constructed to permit of his retaining the position necessary to hold the hose at a proper angle with the pavement to obtain the best results for any length of time. A test in New York

A SMALL MOTOR *street sweeper with air suction and removable dust boxes, invented by B. Kern.*

SECTION *of the Furnas pneumatic cleaner with circulation of air. Section of his latest machine operated by gasoline motors.*



City showed that this method gave only two-thirds of the result obtained by a flushing machine, used four times the amount of water per unit of area cleaned, and cost almost twice as much per unit.

One gang of hose flushers did about 26,000 square yards per day of eight hours and used about 1,600 gallons of water per 1,000 square yards. Street flushing machines are made which do effective work with a reasonable amount of water. These machines consist of a barrel of usually 700 gallons capacity, mounted on wheels. There is also a chamber within the barrel for the storage of compressed air. The outlet pipes from the storage are fitted with fan-shaped nozzles fitted with swivel joints. The water in filling the barrel compresses the air in the barrel and that contained in the water and this compressed air is automatically held in the air-storage compartment until use is to be made of it. The nozzles are adjustable to the angle most effective for use on the particular kind of pacement.

These machines have done excellent work and are pretty generally used, except in New York where they are most needed. One adverse feature in this machine is that the pressure gradually lowers when the air is released until it reaches about 10 pounds and becomes ineffective. The result is that not all the water in the barrel is used before refilling. This feature has been improved by putting a rotary pump, operated by a gas engine, on the machine and not attempting compression of air but giving positive pressure.

These machines clean about 35,000 square yards per machine per day with the use of about 400 gallons of water per 1,000 square yards.

Objection is made to flushing methods because the materials are washed into the sewers. The same objection might be made to hand sweeping, as many sweepers are like some housemaids and sweep the dust into the catch basins to make work eash. The materials need not reach the sewers if the operator knows his business. Many fear that the action of water when used in flushing will wear away the pavement surface or the joint materials. It should, if such a class of pavement or of jointing is allowed to be laid, to expose the paving contractor.

Machine squeegees have their value. They have a spiral rubber scrubber which acts like a hand squeegee and does a proportionately greater work. As usually constructed, the tank of water is on the machine and the discharge is too close to the scrubber for the best effect. If a sprinkling cart is used in advance better results are obtained. In New York, where no sprinkling cart is used, they average 51,000 square yards per machine per day with the use of about 200 gallons of water per 1,000 square yards. In Washington, with a sprinkling cart, they get about 80,000 square yards per machine per day.

There is little value in giving costs in any city, as local conditions govern, prices paid for labor, etc., vary so widely. In New York, however, the costs are approximately per 1,000 square yards:

Hand cleaning	32	cents
Machine broom	32	"
Hose flushing	65	"
Machine flushing	39	"
Squeegeeing	21	"

The system for cleaning streets of the future will be a combination of dry and wet methods; machine work at night and hand broom in the day time. White wings will only be used to remove coarse litter; the machines will take care of the dust.

Street cleaning is an art and deserves serious study. Waring understood this and was ridiculed for taking his work so seriously, but others have believed the

THE HORSE-DRAWN SQUEEGEE *with sprinkler pipes between the axles ahead of the squeegee cylinder.*

same and today each large city has its expert, giving this item of municipal activity proper thought. The first endeavor should be to get better work for the same cost and then lower costs.

There are no good-enough methods unless they are the best obtainable and efficiency is not measured by the cost alone.

Dr. W. V. V. Hayes says: "With the disappearance of the dust nuisance, New York would become one of the most beautiful, healthful and delightful of the large cities of the world," and it should be. Edward T. Hartman says: "The streets in many respects bear on the social life of the community, and until our streets are better constructed and more carefully maintained, we cannot claim for ourselves a high degree of intelligence or a progressive public opinion."

THE ETNYRE STREET FLUSHER
with constant water pressure.

SUPPRESSION OF BILL-BOARDS

Most bill-boards are so objectionable that one would not consider them improvements, but one method of suppressing them is to consider them as improvements to the property on which they are located and to assess them for taxes as other improvements are assessed.

Their forced sale value being no more than their junk value, the assessor would be obliged to consider their real value to be their income-producing ability. A capitalization of the rental paid for their presence on the property could be added to the valuation of the property obtained from a consideration of the other sources of its value, whether as a revenue-producer or, from its location and condition, as a prospective or possible revenue producer.

The owner of a bill-board is ordinarily not the owner of the property on which it is located, so that the "improvement" has value additional to that which it possesses as a producer of revenue for the property owner, thru the rental which he receives. Whether as an improvement of the real estate on the value of which he should be taxed as the owner thereof, or as personal property, it should be possible to reach the owner with a tax somewhat proportional to his net income from it, possibly by taxing the capitalized value of this net income as the value of the property.

The possibility and the method of reaching the proper person, directly or indirectly, by this taxation will depend upon the laws of the respective states, and the effect of such taxes upon the existence of the bill-boards will depend upon the magnitude of the tax which is assessable upon them.

License-fees are tried in some cities with success and in some states can be assessed in addition to taxes on property values.

THE MUNICIPAL ASPHALT PLANT

OF CHICAGO, ILLINOIS.

By Walter G. Leininger, Superintendent of Streets, Chicago, Ills.

The city of Chicago has joined the enlarging group of cities operating asphalt paving plants and repairing their own asphalt streets. In January of this year MUNICIPAL ENGINEERING *published a description of the asphalt heating and mixing plant, to which reference may be made for details. This paper by the man responsible for the work describes the additions made to the plant for the use of the gangs doing the paving work and gives figures of work done, men employed and cost of operation.*

IN all cities where repair work is done by contract, the sum of money expended is large in proportion to the yardage repaired, and in order to get repairs done quickly by this method, a great deal of time is expended in notifying the contractor and estimating and finally settling on the work actually done. The city must keep all records of yardage, cost, etc., just as completely as if they were doing the work themselves. Hence, when the bureau of streets decided to do their own asphalt repair work, it was necessary only to add a field force to the men already engaged in this work. The first year that any attempt was made to repair by day labor, all material was purchased at the plant of a contractor. The hauling and placing was carried on by the street department. Chemical tests were made of all material purchased, and altho the mix and material was good, the bureau had no opportunity to try a new method, mix, or material, where they felt the same might give better results. It was the necessity of a plant for this purpose, and the cheaper manufacture, that resulted in the building of the present municipal asphalt plant of the city of Chicago.

The next problem that confronted the department was the location. It should be centrally located to the area of asphalt streets or contemplated asphalt streets. The location chosen was first considered by many as unfit for such an undertaking, Fifteenth Place between Loomis Street and Ashland Avenue, is 66 feet wide and is bounded on both north and south by elevated steam railroads. The walls supporting these tracks are 17 feet in height and afford an ideal side track where material can be unloaded into bins along the wall, or lowered in the elevator constructed for this purpose.

The plant proper was constructed by Hetherington & Berner, at a cost of $46,000.

The department then took up the matter of additional buildings to be used as office, scale house, chemical laboratory and baths. The plant today represents approximately an expenditure of $75,000.

The plant can be utilized for the manufacture of top, binder or bituminous mixtures, and has a rated capacity of 2,000 yards of finished pavement per day of eight hours. By finished pavement is meant two inches of top and two inches of binder.

The plant is run on a different basis from other cities. A credit of $75,000 was placed at the disposal of the plant, the same to be known as a capital account. This amount gave the plant the required money with which to purchase supplies

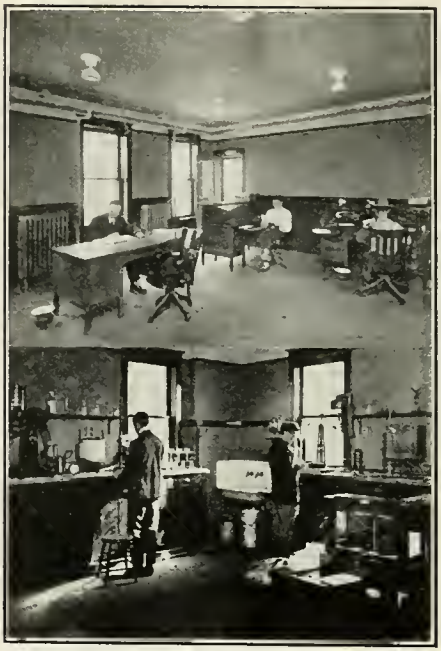
CHCAGO ASPHALT PLANT. *Entrance for visitors and exit for loaded wagons. Office on right with chemical laboratory in right side and store room in rear. Scale room, office and bath room in building next in rear. Asphalt heating and mixing plant in center at rear. Elevator for unloading cars on switch track seen in rear and between office and plant buildings. Sand and stone dust storage seen at right of asphalt plant. Asphalt storage at far rear of lot. Car service track on the right, elevated. Elevated railroad tracks on both sides.*

and material for the year's work. Each of the thirty-five wards in the city is credited with a certain per cent of the vehicle tax fund, based on the amount of collection in that particular ward. Hence, when the plant is furnishing material for any ward, it is charged for at a standard price per ton; this price is sufficient to allow for all overhead expenses plus depreciation. It is interesting to know that these prices are much lower than could be procured by contract. The charge for top mixture is $7.50 per ton, for binder $4.50 per ton and for bituminous macadam $5.00 per ton. The actual cost to the plant for top is $5.75, for binder $375 per ton and for bituminous macadam $4.00 per ton. Hence, during the operation of the plant an earning of $4,000 average per month will be shown. This earning holds the capital account stable and allows for all depreciation, repairs and the like.

The asphalt repair division is under direct supervision of a general foreman of asphalt repairs, who reports directly to the superintendent of streets. In this way, rapid operation and decision is acquired.

Upon entering the plant from Ashland avenue, at the right stands the office of the plant foreman, above which is the chemical laboratory. First behind the office is a long storage room where parts and tools for all kinds of asphalt work are held in reserve. The next building to the right is the office of the scaleman, where all material is weighed as it leaves the plant. Just behind this office are the locker room and shower baths. Here the men dress and wash and at the close of the day's work leave the plant refreshed and clean.

All apparatus in and about the plant is of the latest and best type. The chemical laboratory is in charge of a chemist and his assistant, who employ two samplers. The laboratory is light and airy, well ventilated and fitted with hoods in which all gases are carried off. All testing apparatus is of the best, and arranged in the most efficient manner. All materials used in connection with the plant and the work are tested by standard methods to insure the best results and to obtain a good compliance with the bureau's specifications. Copies of all tests are placed on file in the bureau, and a duplicate is retained at the plant. In this way all department heads, inspectors, etc., are kept in touch with the class of material being



CHICAGO ASPHALT PLANT. *Above is the interior of the office and below is that of the chemical laboratory, situated at the right of the room shown in thv upper picture.*

CHICAGO ASPHALT PLANT. *Above is the interior of the scale room with scale at the right and office room in the rear. Below is the bath room and lavatory, with lockers for the men at the right. Both rooms are in the same building.*

used. All requisitions for material bear the signature of the chemist, showing that the material is correct in all respects. Not only raw material but the mixtures made for repairs are tested from time to time, so that at any time the mixture used on any job can he ascertained and the results of wear noted. All entrances to the plant are paved with granite block and all portion kept in excellent condition by the watchmen. A sewer directly thru the street takes care of all drainage of roadways and pits. All storage tanks are placed underground where practicable, and encased in concrete. The plant is electrically operated and lighted so that it can operate at night if necessary. This current is furnished by contract from the Sanitary District of Chicago at the regular rate for plants of this nature. The force which has been found necessary in order to operate, includes:

1 Foreman of asphalt plant.
1 Foreman of drum men.
2 Drum men.
3 Kettle men.
1 Mixer man.
15 Laborers.
1 Chemist.
1 Assistant chemist.
2 Samplers.
2 Watchmen.

The street repair gangs, which range from two to five in number, depending upon the amount of work and the period of the year, are composed of the following:

1 Foreman of asphalt repairs.
1 Foreman of cut outs.
3 Rakers.
3 Smoothers.
3 Tampers.
30 Helpers.
1 Roller man.
2 Watchmen.

With each gang are sufficient teams to keep material constantly at hand and remove old top. The hauling of material will be greatly improved and cheapened in the near future for the bureau has

purchased two five-ton Pierce-Arrow dump trucks to assist in the long hauls. It is estimated that each truck will take the place of 3½ teams on this work.

The first attempt by the bureau in 1912 to repair streets out of reserve was done by contracting for material at the plant of a contractor by the ton. Hauling and laying was done by the city's forces and altho the cost of material was high, the results were pleasing and the work was of a high standard. This high standard is showing more and more each year by the decrease in the yardage to be repaired on streets where careful work was done.

In the first year's work the following will give an idea of the saving even by the purchase of a contract mixture:

Out of reserve and maintained in 1912, sq. yds. asphalt...	2,059,000

CHICAGO ASPHALT PLANT. *Store room in rear of office. Note completeness of outfit and systematic storage so that any article needed is quickly found.*

Total sq. yds repaired.....	76,488
Total cost of repairs.....$	105,160.52
Average cost per sq. yd.....	1.375
Average cost of maintenance per sq. yd.....	.051

Previous to this time all repair was done by contract, and a fair average of maintenance cost was about $.06 per square yard.

CHICAGO ASPHALT PLANT. *Second floor, showing flux, asphalt melting and mixing tanks in room in foreground; upper end of sand and stone elevators and conveyors in rear room; both discharging into mixers in room at right of the latter.*

The first year of operation with the plant was 1913 and the results are exceedingly encouraging, since the plant force was being broken in and the new machinery worked hard, as is usual with a new plant of this size. The system of getting material, unloading and storing the same in convenient places, was also a new proposition and the storage bins were not then completed. Nevertheless, considering all the drawbacks to the opening and operation of a new plant, the following results speak for themselves:

Out of reserve in 1913, sq. yds. asphalt	4,309,200
Maintained by the bureau in 1913	3,547,600
Total yards repaired	147,638
Total cost of repairs	$119,828.63
Avg. cost of repairs per sq. yd.	.8116
Avg. cost of maintenance per sq. yd.	.0338

We are looking forward to another decrease in the cost for the present year. Just what the cost will be cannot now be estimated, since the quantity is large and the bureau has been reaching out in other lines.

The proposed repair work for the year is laid out on a small map by the general foreman in charge. Care is taken to district this work in a manner that will require the shortest moves and a system of streets is repaired in one location before moving on to the next. The first move made upon the arrival of the gang upon a street is to mark out the cuts to be made and holes to be repaired. This is done by the foreman of cutouts, and passed upon by the general foreman. As fast as the cuts are made and trimmed, the old material is gathered up and taken away. The painting of the edges is next completed by using asphaltic cement. The binder gang then follows up, bringing up the repair to within an inch and a half to two inches of the top. The binder is tamped and smoothed, ready for the top. The top is then laid, raked, smoothed and ironed; after rolling with a five or eight-ton roller the top is dusted with cement and barricaded with wooden horses until ready for opening the street to traffic.

Record of all asphalt streets in the city, as well as those of other materials, is kept by map and card index. All streets under the contractor's reserve are placed on the map under a distinct color in dotted line, and as soon as this street falls to the city to maintain, the line is made solid. All dimensions, data, etc., pertaining to this street are filed alphabetically in a card-index file and on the reverse side a complete record of repairs is kept, showing yardage repaired, cost, etc. In order that the superintendent of streets may keep in constant touch with the various repair gangs, a map with colored thumb tacks showing the loca-

BOTH SIDES OF CARD *used for keeping record of asphalt repairs in detail.*

Madison St

Ref No	From	To	Date of Contract	Date of Restriction	Contractor	Ward	Width Roadway	Width Pavement	Length	Yardage	Kind of Pavement	REMARKS
1	Canal	Clinton	95	00	Citizen	18	46.3	46.3	340	616	Asph.	Macadam base
2	Clinton	Racine	97	07	Conroy	18	48	48	4188	15988	"	concrete base 6"
3	Racine	Ashland	97	07	Barber	18	48	48	2567	9915	"	" " "
4	Ashland	Robey	98	08	Bran	18	48	48	2604	9856	"	" " 8"
5	Robey	Oakley	98	08	Columb	18	43	43	2504	8094	"	Resurfaced Brick
6	Oakley	Western	99	09	Barber	13	43	43	614	1225	"	concrete base 6"
7	Western	California	00	10	Conroy	13	44.5	41.5	2261	6739	"	" " 8"
8	California	Homan	01	11	"	13	48	45	3903	12941	"	" " "
9	Homan	Central Pk	02	12	"	13	49	46	1290	2192	"	South ½ concrete
10	State	Michigan	03	13	Barber	1	47	39	946	3459	"	concrete base
11					Front of Card							
12												

Year	Ref No	Inspector	Contractor	Total Yardage Repaired	Per Cent	Field Book	Cost of Maintenance	Maintenance Cost Per Yd.	
1912	10	Fisher	City	231	6.68	7/12	500.62	0.145	2½" Top
"	6-7 8-9	Dillon	"	785	3.39	8/20	1288.93	0.056	2" Top
"	1-2-3 4-5	Brown	"	4226.5	9.5	8/22	7240.74	0.163	2" Top 1½" Binder
1913	10	Crowley	"	57	1.65	15/2	77.30	0.022	2½ Top 2" Binder
"	6-7 8-9	LaVelle	"	1720	7.45	15/6	1521.56	0.066	2" Top
"	1-2 3-4-5	Dooley	"	4875	10.96	18/3	4671.72	0.105	2¼ Top
				Back of Card					

tion of each gang is kept. A location report is sent to the office of the bureau each night, by the various foremen, and the plat is kept up to date in this way. The location of road rollers is noted by the same method and in this way the shortest moves for the machines can be planned by the assistant superintendent in charge of repairs. Each roller bears a number. The duplicate of this number appears on the location map.

The total capacity of the storage bins is approximately 860 cubic yards of sand and stone. The cement is kept in a brick-lined room, air and water tight. Five hundred barrels of cement are kept in readiness for use at all times.

From the storage bins the material is carried by conveyors to the hoppers located at the top of the plant. From these hoppers it is fed to the different mixers as required. After mixing it is conveyed to the wagons and arrives on the job at from 280 to 320 deg. F.

Each wagon is loaded in approximately ten minutes, and top and binder can be loaded at the same time, there being two mixers. Besides the manufacture of top and binder, the plant turns out all asphaltic filler required for brick and granite block repair. The liquid asphalt used for building macadam streets by the penetration method is also made at the asphalt plant. The plant is at present using the following brands of asphalt: Trinidad Lake natural asphalt, Cuban and different brands of blown oil product.

The department this year purchased twenty 3-yard asphalt wagons. When other wagons are needed they are hired by the day. The city owns no horses. The largest number of asphalt wagons working this year was sixty and this number varies from time to time a great deal, depending on the length of haul.

In the beginning, naturally all eyes were focused on Chicago in this undertaking, and co-operation was not asked nor expected from outside concerns interested in the asphalt work. The success of the undertaking is based on hearty co-operation of the city's forces and the interest displayed by the competent men in charge. The best material linked with care and pains in laying the same have insured the best results. The experiments carried on from time to time on new mixtures and the action under traffic carefully noted, give the men in this work the ability of quick decision and choice on streets coming up for repair. At the present time the resurfacing of old granite block and brick pavement is being carefully watched. These results will be known in a year or so. Each year more and more asphalt pavements besides those of other materials run out of the contractor's reserve period, and fall to the bureau of streets for maintenance. Naturally, it is to be expected that the present plant and equipment will be inadequate to supply the wants, and in the future an additional plant, of size and capacity necessary, will be required. This plant will be located at a central point to the increased area. So far it has not been necessary to run the plant at the maximum capacity and we are not positive of the overload it is capable of caring for. It is also a fact, that with a few slight changes or additions, the present capacity of the plant can be greatly increased.

TYPES OF FIVE-TON TRUCKS *used for hauling hot asphalt mixture from plant to street.*

PAVEMENT ECONOMY

By H. B. Pullar, Engineering Chemist, Detroit, Mich.

In this paper before the League of Michigan Municipalities the author, who has had much experience in bituminous pavements of various kinds, presents some of the important factors in the economy of pavements, especially as to the necessity of taking local conditions into full consideration. The editor has selected some illustrations, not to point the moral of the author's paper, but to show what good results can be obtained with kinds of pavement he excludes from his consideration. Part of these have good results because economy is a secondary consideration and the roads receive all the attention they require to keep them in good condition. Part of them are built of the closed types mentioned by the author. He promises a paper later descriptive of a pavement of the open type which he commends.

THE economical pavement is a subject of much discussion, but like the proverbial fountain of youth it still remains undiscovered. Many claims have been made for the different types of pavements on the market and almost any promoter, material man or contractor, believes that he can, if given the proper amount of time, convince you that his is the only economical pavement. The truly economical pavement is the one best suited to meet the local conditions which will withstand the ravages of time and traffic with the least possible maintenance, first cost considered.

The old Roman roads with their foundations two or three feet, and in some cases as much as six feet in thickness, were economical roads and pavements for their time, for they not only met the conditions of their time, but have stood the traffic of centuries. To build a Roman road in modern times, however, would not be economical or wise. An American administration attempting to lay a Roman road would probably not only start a vigorous protest of abutting property owners but would find a quick demand for a change in administration. While the history of the old roads of the Roman Empire, France and England, is interesting and they have been of great service in the development of modern type of pavements, they can no longer be used as models.

Americans, with their nervous, progressive and energetic spirit must solve their own paving and road problems to meet their own particular conditions.

The principal considerations in determining the economical pavement are the traffic and climatic conditions to which the pavement must be subjected, available materials and their cost, assessed valuation of abutting property, and the probable result of the improvement.

Before a pavement is laid the climatic and traffic conditions should be given most serious consideration and should be a big factor in making the final determination. In the large cities where traffic is heavy, granite or wood block are very largely used. This is because these two types of pavement have been found to withstand heavy traffic more satisfactorily. Where the question of excessive noise is not material, the long life and small difference in cost, and the ease of repairs and low cost of maintenance, make granite block the favorite; while on a heavy traffic street lined with office buildings or stores, where the question of noise must be taken into consideration, wood block is constantly increasing in favor. It would be folly indeed to lay a concrete

WATERBOUND MACADAM *on Vernon Road in the city of Philadelphia, showing successful maintenance by resurfacing by city forces, without regard to relative cost of maintaining various kinds of pavements.*

pavement, bituminous or water bound macadam, or any other cheaper type of construction under such conditions. In considering the traffic conditions to which a pavement must be subjected it is always necessary to take into consideration the probable increase in traffic after the pavement has been laid, and in many instances it is advisable to take traffic census for the proposed improvement. It is not uncommon for the traffic of a road or pavement to double in volume after the improvements are made.

Another very important matter in considering the traffic conditions, is the kind of traffic. Where horse-drawn traffic prevails, a pavement should be made to aid this class of traffic; and where motor traffic prevails, a different type of pavement entirely may prove to be the most economical. Probably one of the best examples of this kind can be cited in Wayne County, Michigan. Almost everybody interested in paving has heard more or less favorable comments as to this large mileage of concrete roads. Cement manufacturers and promoters have advertised these roads from one end of the country to the other, but in trying to convince you that concrete roads will be the most economical pavement for you to lay and in telling you about these Wayne County roads they usually forget to give all the facts, and fail to realize that because in Wayne County or some other place concrete has given successful results, it will not necessarily prove to be successful for your own work. The traffic on the Wayne County roads has been reported as being over 80 per cent. motor traffic, and a large per cent of this motor traffic is pleasure vehicles. The roads are and have been constructed by the most up-to-date methods and repairs are made immediately any defects appear. Were these conditions reversed, and the concrete roads in Wayne County compelled to withstand over 80 per cent. of horse drawn traffic or even a much higher percent of heavy commercial car traffic, they would probably not prove to be the most economical,

and the reported low cost for repairs and maintenance would be considerably increased.

Climatic conditions should be given consideration when determining upon the most suitable type of pavement. In England it was found that asphalt pavements laid similar to those in America deteriorated very rapidly, and the cause was found to be the heavy fogs. A higher percentage of asphalt was used to overcome this trouble and more successful results were obtained. The southern part of this country requires a bituminous material of different consistency than that used in the northern section.

Bituminous pavements to give most successful results must have suitable drainage, and while this is true of other pavements it is specially true of all bituminous work. The climatic conditions of Michigan permit the use of many and various types of pavements, and they are not as important a matter as in other parts of the country.

The availability of materials is often given but slight consideration in determining the type of pavement to be constructed, and yet it is of the utmost importance in some localities. Where good sand is available at a low cost and where other conditions are equal, how foolish it is to import brick from another state in preference to laying sheet asphalt pavement, which is composed of about 80 per cent. of sand, whereas the reverse would be true if it were necessary to import sand into a town in which there is a brick plant turning out high quality brick. There are conditions in different cities which makes it advisable, even at a much higher cost, to favor one type of pavement over another, but where the truly economical pavement is desired and other conditions are equal, the availability of materials should be given careful consideration.

THE MALL, *Washington, D. C. Asphaltic macadam, treated with Trinidad liquid asphalt, penetration method. A fine example of a well-maintained driveway built by this method.*

In determining the most economical pavement the assessed valuation of the property is too often considered to be of minor importance, and politics and real estate promoters are frequently the cause of sheet asphalt pavements being laid out in the country, while the old unreliable water-bound macadam pavement remains in the heart of the city. We find many instances where expensive wooden block pavements are laid on light traffic residence streets with heavy assessments made against the abutting property owners, who can ill afford them,

BITUMINOUS SURFACE TREATMENT *on waterbound macadam on City avenue, a suburban street in the city of Philadelphia, maintained by city forces. Note tendencies toward raveling of surface in many places.*

while in the main business streets a cheaper type of construction is used with a heavy maintenance coming out of the general taxation fund. This practice is certainly contrary to all ideas of economy, and there has been much waste of public funds in cities where such conditions exist. A careful consideration of the needs of a street and the assessed valuation of the abutting property will not only result in better streets, but will cause a much lower general maintenance charge on all paving in the city and a more equal and just distribution of the paving fund.

The medical profession, with its great scientists and students, is continually finding new cures for what have been previously considered incurable diseases. Likewise the engineering profession, by its scientific studies and research work, will continue to overcome the numerous and difficult problems of paving construction. The economical type of pavement is distinctly an engineering problem and its solution for any particular street or locality will depend upon the efficiency of your engineer. The time is coming when the city engineer will be given more authority to direct and more opportunity to study and work out to advantage his paving problems. A successful manufacturer would soon lose his business and turn his dividends into losses were he to employ a new superintendent each year; as he would, also, if he should employ a capable superintendent to look after his business and then only spasmodically assist him in his work, or fail to give him authority to go ahead. So the choice of the economical pavement must be left with a capable engineer, receiving a big compensation and with full authority to

direct his work, and in this he should receive the co-operation and help of all officials and citizens.

While I have endeavored to give you a general idea as to some of the important features to be taken into consideration when deciding upon the economical pavement for your city or town, I will endeavor to give you a short description and history of what we believe to be one of the coming types of economical bituminous construction. This is known as the open type of asphaltic or bituminous concrete.

With the advent of the automobile and the demand for a more permanent type of construction than the water-bound mecadam, the bituminous macadam laid by the penetration method was one of the first to be considered and has been most extensively used. For a time it seemed to have solved the problem, but failures have been too frequent and costly. While there are many good bituminous macadam roads which were constructed by the penetration method, the many small details which must be carefully looked after in order to get successful results have made the proportionate chances of failure so numerous that it is always with more or less uncertainty of results that a penetration job is constructed. The principal causes of the failure of bituminous pavements laid by the penetration method are the impossibility of thoroly coating each particle of stone and the segregation of the stone, making it impossible to obtain an even distribution of the bituminous material. The result of this is that there are numerous spaces in the road which allow water to penetrate, causing the pavement to disintegrate rapidly.

ROADWAY OF BUSTLETON PIKE *in the city of Philadelphia, resurfaced with Amiesite, showing good condition of this type of asphaltic macadam.*

Another type of bituminous pavement which has found great favor, is the bituminous concrete, which is a mixture of asphalt, sand and stone. This type of pavement would find greater favor were it not for the fact that certain patents to cover practically all mixtures of stone and sand have been held valid in some of the courts; and on account of the undesirability of getting into any patent litigation cities have hesitated in adopting this type of construction.

Because of the uncertainty as to the results obtained from the penetration work and because of the desirability of getting a cheaper type of bituminous pavement than the asphaltic concrete or sheet asphalt, the open type of asphaltic or bituminous concrete has been developed and has met with much favor in different sections of the country. This type of pavement, however, is not a new one, having been used many years ago with a tar binder. The pavement consists of a mixture of stone and bituminous cement acting as a binding medium.

The stone is heated to a suitable degree of temperature, depending upon the bituminous material used, and then mixed with bituminous binder in suitable proportions. It is laid similar to sheet asphalt or asphaltic concrete. The mixture is laid from 2 to 3 inches in thickness

and properly rolled. After rolling there is applied a squeegee coat of pure asphalt cement and while the coating is still hot stone chips are thrown over the surface. The whole pavement is then re-rolled so the squeegee coat is forced into the voids, making a tight, uniform, waterproof and and durable surface. Heating the stone and then mixing in asphalt so that each particle is thoroly coated, prevents the trouble which causes so many failures in the penetration method and prevents any segregation of stone.

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¶ PRACTICAL EXAMPLES *of the open type of asphaltic concrete pavement exist in Michigan and others are under construction.*

The city of Lansing last year tried out this type of pavement on some of the principal streets with most excellent results at a very low cost. On account of the results obtained at Lansing, the State Highway Department of Michigan will put in a strip of this same type of pavement in Oakland County, which is an extension of the Woodward Avenue pavement of Detroit. This section of pavement will join the concrete road of Wayne County and will afford an excellent opportunity for a comparison of the two different types for the same traffic. There are a number of other cities in the state which have already laid considerable yardage of this open type, and which contemplate laying in the future a large amount of this work.

The open type of asphaltic concrete pavement is free from infringing on any patents, thus removing any cause for litigation. Although there are about 35 per cent. of voids in the mix as it comes from the mixer the stones key in together giving the wearing surface stability, thus preventing shoving and rutting. In fact, the finished pavement is similar to waterbound macadam with the exception that each stone is bound together with asphalt cement. The asphalt cement prevents any dislodgement of the stone from either horse-drawn or motor traffic.

The first cost of this pavement is very nominal compared with other types, being slightly higher than that of the penetration and considerably less than the closed type of bituminous concrete or sheet asphalt. With the average conditions in Michigan these pavements can be laid by contractors for from $1.10 to $1.40 per square yard, including 6-inch concrete foundation, but if the pavement is put in by the day labor plan, under the supervision of the city engineer, the cost should be considerably lower. In fact, I believe the total cost of the paving at Lansing did not exceed $1.10 per square yard, and the city used crushed cobble stone instead of limestone, which added considerably to the expense.

The open type asphaltic concrete pavement after traffic has been on it for some time looks almost the same as the closed type, or like bitulithic. It is easy to repair, pleasing in appearance and makes a sanitary and noiseless pavement. There are many cities and towns thruout Michigan, especially in the residential sections, where this type of construction would be advisable. I think it would prove to be the economical pavement and I believe that it will constantly grow in favor with engineers and officials in charge of paving work.

There is another item to be taken into consideration in discussing the economical pavement. No type of construction and no materials, no matter how high the quality or how successful they have been in other places, will be satisfactory in any locality unless they are properly constructed. Just because a pavement or a particular type of construction has given successful results in one town or one locality is no indication that it will be equally successful in your city or town unless every precaution is taken to see that the numerous small but important details are carefully looked after. The best of materials cannot give good results unless properly handled, while better results can be obtained with poor materials properly applied.

It is not, by any means, always economical to award contract to the lowest bidder and a difference of 5, 10, or even 25 or 50 cents per square yard in the original cost may in the end prove most economical.

In conclusion, I would state that the

economical pavement of today is not any particular type or any particular material, nor is it a pavement put in at any particular cost. It is a pavement carefully selected after an exhaustive preliminary examination by an efficient engineer to best meet the demands of the particular locality in which it is to be constructed. It is a pavement laid in direct accordance with the requirements of carefully prepared specifications, which should be reasonable and just to both the city and contractor. It is a pavement in which only the most suitable available materials for its particular type of construction are used; a pavement laid under the direction of an efficient and capable engineer, with authority to direct and supervise the many details of construction and to appoint inspectors for their efficiency and ability to carry out his orders, rather than for their ability to obtain votes at the next election. The city or town in which this condition exists, while it may continue to have a failure now and then, and while it may not find the one economical pavement, will come nearer to solving the problem and satisfying the tax payers, to whom all public officials in the end must look for commendation.

DARTMOUTH STREET, *Boston, Mass., laid with bitulithic on macadam foundation in* 1903, *as it appeared in June,* 1914, *showing durability of this type of bituminous pavement.*

SEWAGE DISPOSAL

AT BERGEDORF, GERMANY.

By Kenneth Allen, Consulting Engineer, New York City.

The author of this clear description of a new sewage disposal plant in a suburb of a large city has recently returned from a trip thru Europe for observation of foreign methods of treating modern sanitary problems, for which he has been well fitted by years of successful practice in the same field in this country. His report of what he has seen is therefore of more than usual authority.

THE "Free and Hanseatic City of Hamburg" is in many respects an autonomous state, possessing, like Bremen and Luebeck, certain powers and privileges not held by other German municipalities, and the territory covered may include areas separated from the city proper. The village of Bergedorf lies on such an area, about ten miles southeast of the center of Hamburg, on a small stream which enters the Elbe above the city. On account of this location the Hamburg authorities have recently constructed a plant for the thoro treatment of the sewage.

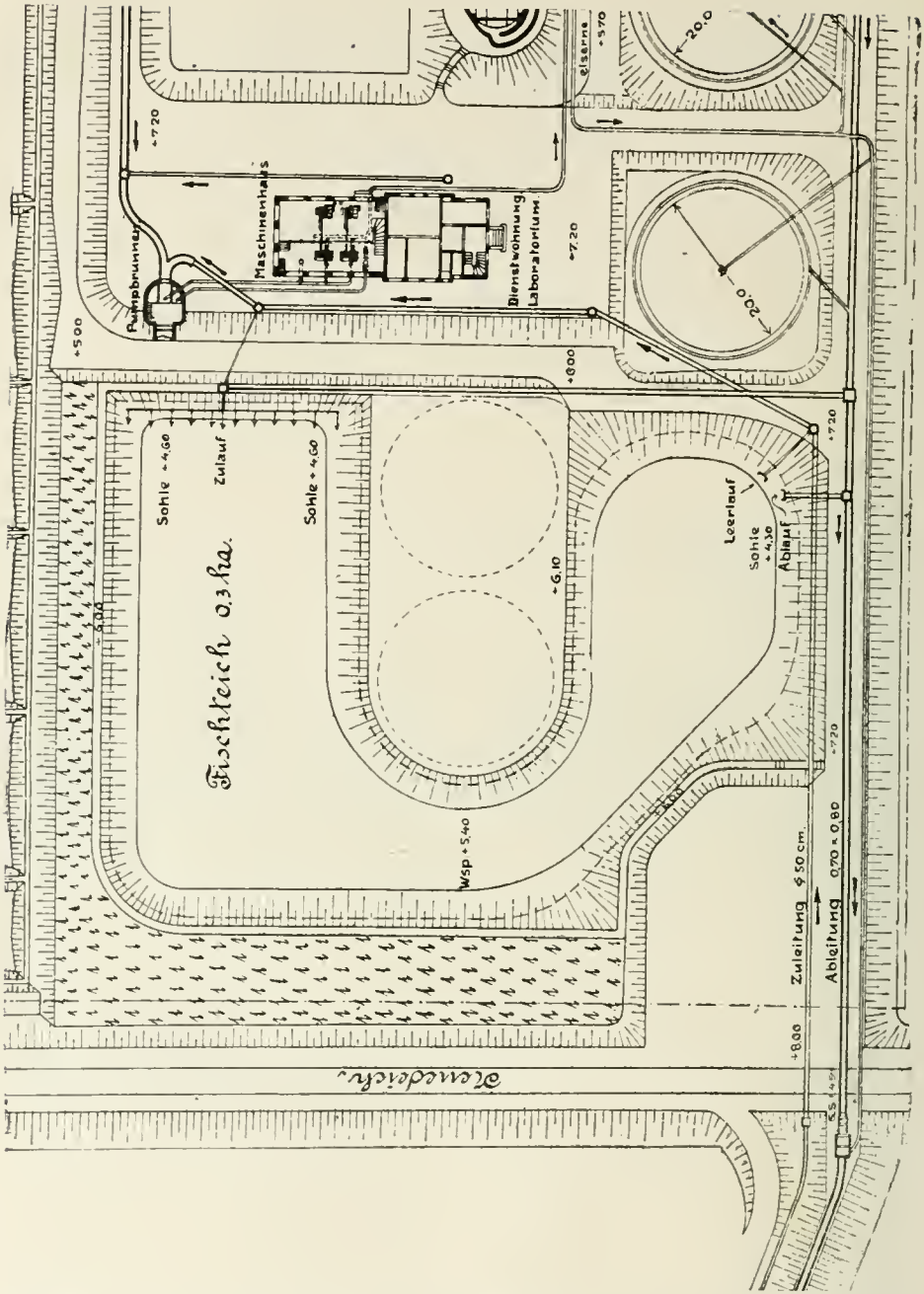
The population of Bergedorf in 1910 was 14,900, and the volume of sewage when visited in June, 1913, was estimated at 600,000 gallons (2,250 cu. m.) per day, exclusive of storm water. The maximum flow received by the plant contains over three times this amount of storm water, or 2.6 million gallons (99,000 cu. m.) daily, the excess passing by overflows to the stream. The sewage is quite fresh when received, as the plant is but 1¼ miles (2 kilom.) from the center of the town, but contains much manufacturing waste. It is brought by two trunk sewers to a pump well 13.3 feet (4 meters) in diameter by 9.9 feet (3 m.) deep, which also serves to intercept grit and which contains a screen of bars placed 0.64 in. (16 m. m.) apart, for the purpose of intercepting the coarse floating material.

Two 8-h. p. Diesel motors operate centrifugal pumps, each of 1.75 cu. ft. sec. (50 lit. sec.) capacity, during the day while a smaller, automatic electrically operated pump is used at night. The latter requires 3 h. p. and has a capacity of 1.05 cu. ft. (30 lit.) sec. Diesel motors were selected on account of their economy in operation. The fuel used is the by-product from the distillation of coal, lignite and petroleum and is consequently inexpensive, while the efficiency of the motor is very high, 33 per cent. The pumps lift the sewage about 20 feet (6 m.) to the plant.

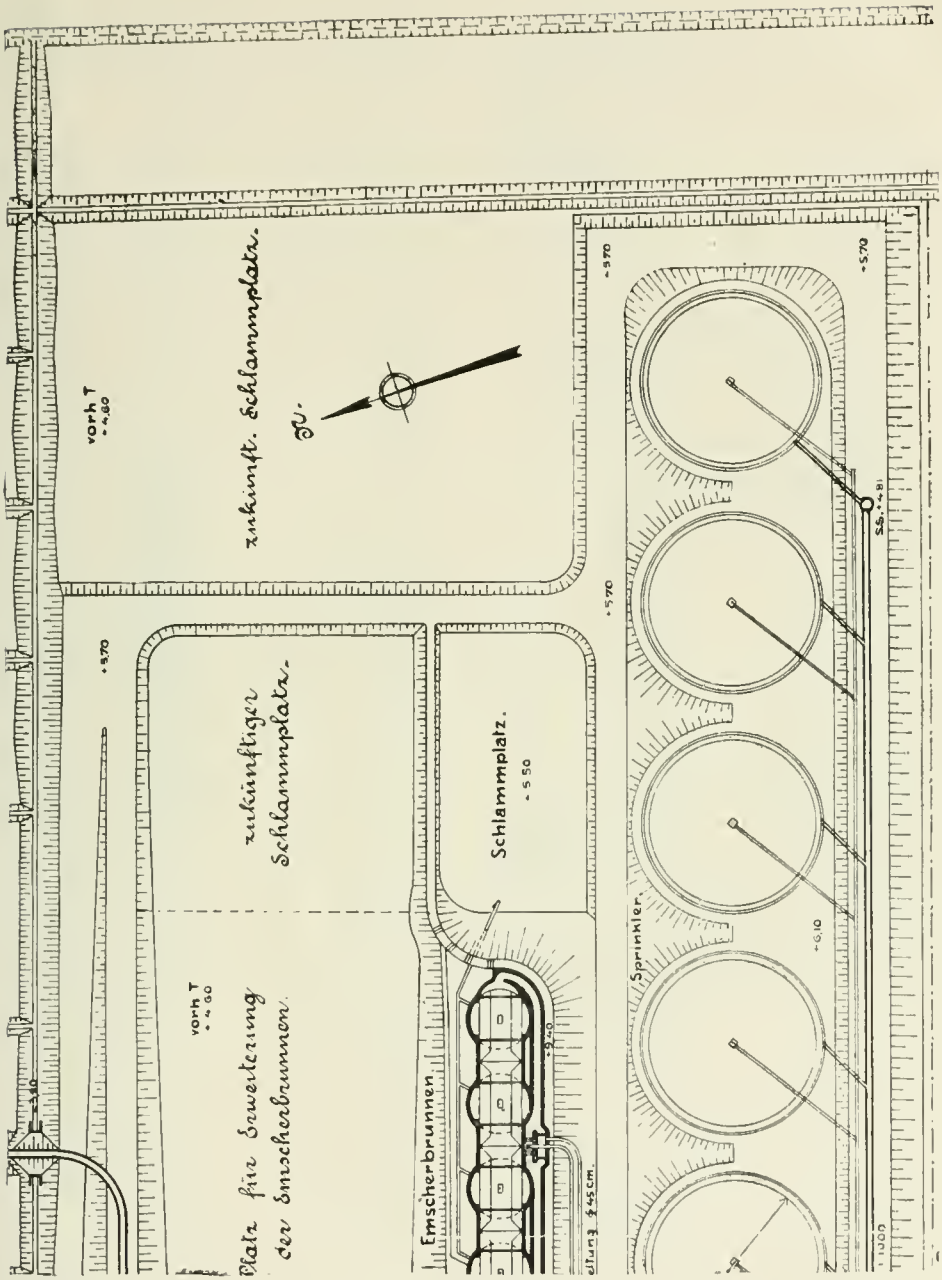
The works were put in operation in October, 1912, and consist of Emscher tanks, sprinkling filters and fish ponds.

There are four reinforced concrete Emscher tanks, operated in series or in two pairs, as desired. The sedimentation chambers are of a size to afford a 2-hours' period of retention for the dry weather flow and a mean velocity of one foot a minute (5 m. m. per sec.) and a period of retention of 40 minutes with a velocity of three feet per minute (15 m. m. per sec.) during storms. Here 67 per cent. of the suspended solids or 90 per cent. of the settleable solids drop to the sludge chamber beneath, where they remain three or four months (six months preferred) until digested. The sludge chambers are 23 feet (7 m.) in diameter and extend to a depth of 29.6 feet (9 m.). When visited, the actual depth of sludge was about 16.4 feet (5 m.)

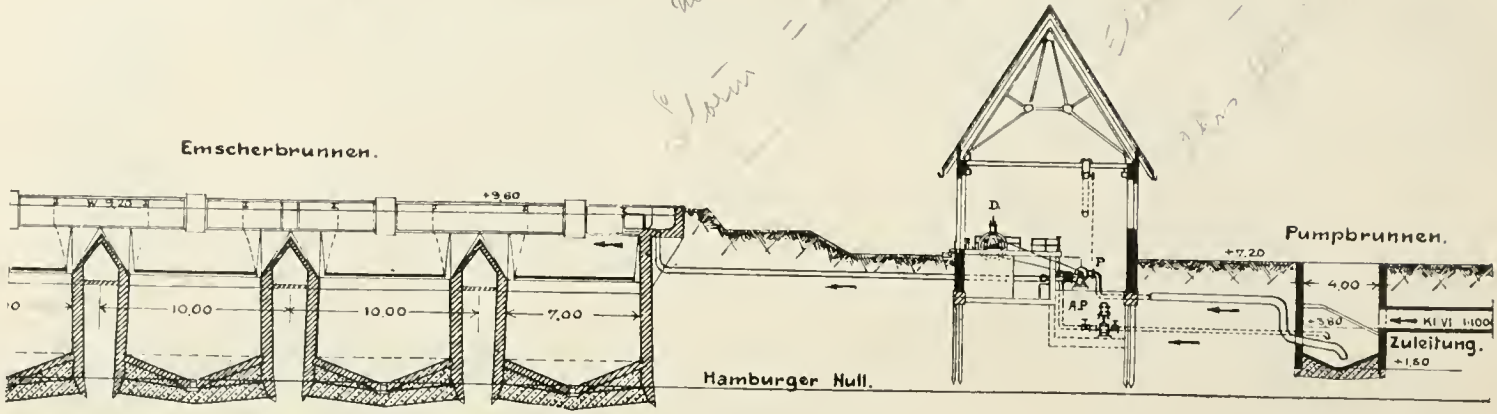
When drawn off by the hydrostatic pressure of the liquid above, the sludge was seen to be nearly black, of the consistency of syrup and with very little odor. After



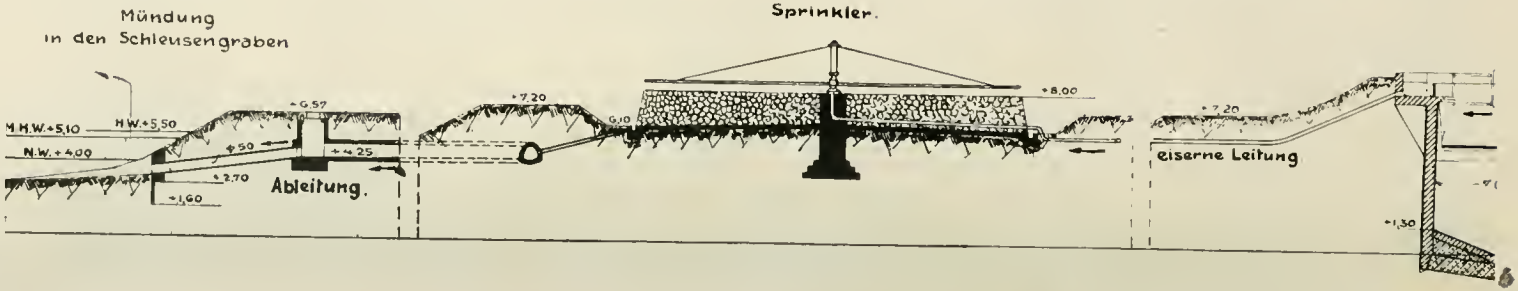
SEWAGE *enters the pump well (pumpenbrunnen) thru two pipes (zuleitung) from upper left and lower right corners, is pumped by centrifugal pumps in the pump-house (maschinenhaus) to the Imhoff tanks (Emscherbrunnen) shown on opposite page, runs thence to the sprinkling filters (sprinkler) and after passing thru them flows to the settling tank (fischteich) above and thence out by pipe (ableitung) in lower right corner.*



ONE OF THE INFLOWS *of sewage enters the plant near the lower left corner and goes thence thru the pipe shown to the pump well shown on opposite page. The Imhoff tanks (Emscherbrunnen) and sprinkling filters (sprinkler) are shown in this half of the plan. The sludge from the Imhoff tanks is drained into areas marked "schlammplatz" to dry prior to removal. Space for additional Imhoff tanks and sludge beds is shown adjoining those now installed.*



THESE TWO CUTS *show the flow of sewage thru the plant in section. The sewage enters at the right (above) thru the pipe "zuleitung," flows into the pump well (pumpenbrunnen), is thence pumped, flowing in the direction of the arrows thru the pump house to the top of the Imhoff tanks (Emscherbrunnen). Below, the sewage is shown flowing from the Imhoff tanks thru the iron pipe (Eiserne leitung) up thru the center of the sprinkler, by which it is distributed over the filter beds by the revolving horizontal arm swinging on the central bearing. From the outlet of the filters it flows thru the effluent pipe (ableitung) into the Schleusengraben ship canal and thence into the Elbe river.*



drying on sand beds 6.6 feet (2 m.) thick, with underdrains for two weeks, it was quite dry and smelled only of garden mold.

There are four sprinkling filters of the rotary type, 65.6 feet (20 m.) in diam. and 5.9 feet (1.8 m.) deep, constructed of slag obtained from the incineration of refuse. The material is very coarse, being about the size of a man's fist, with the enclosing walls of pieces perhaps 6 or 8 inches in diameter. It did not appear to be as hard as would be desirable but was no doubt less costly than broken stone and from experiments made with similar material elsewhere the local authorities believe it will remain satisfactory for a period of from 16 to 20 years.

The rotating sprinkling device, furnished by the Geiger Manufacturing Co., of Karlsruhe, consists of four perforated pipe arms suspended and receiving their supply of sewage from a central vertical shaft. Two of these arms connect with the central shaft by an upward double bend or goose-neck, of such a height as to prevent the full flow of sewage to these arms except during storms. The dry weather flow, therefore, is distributed to the filter by the other two arms with, perhaps, a small amount from the outer ends of the arms provided with goose-neck connections. By this device a better velocity is maintained in the arms, avoiding deposits, and a more uniform distribution is effected on the filter. The writer was told that up to the time visited no stoppage had occurred in these sprinklers and that no difficulty had been experienced from winter temperatures.

Flies were quite numerous on and about the filters and a large part of the organic material in the sewage is found to be converted into worms and other minute organisms. The effluent, when noted, was very clear.

From the filters the effluent flows to artificial fish ponds without passing thru the settling tanks usually provided in such plants. These ponds, which were not complete when visited, were to be stocked with carp which, it was believed, would find an excellent food supply in the worms, etc., washed from the filter.

From these ponds a 23x2.6 ft. (.70x.80 m.) conduit carries the effluent to the Schleusengraben ship canal, which leads to the Elbe. The tidal range in this canal is from elevation 13.1 (4.00 m.) to 16.7 ft. (5.10 m.), or 3.6 ft. (1.10 m). When the surface rises above elevation 19.0 ft. (5.80 m.), or 2.3 ft. (0.70 m.) above mean high water, the operation of the sprinklers is stopped and reliance placed on the Emscher tanks only.

The cost of the 8-h.p. Diesel motors was $1,430 (6,000 mk.) each, and that of the entire plant about $83,500 (350,000 mk.). The plant is so arranged that additional units can be added when required, doubling its capacity.

The writer is indebted to Baudirektor Sperber and Dipl. Ing. Keitel of Hamburg for much of the information regarding these works.

LIGHT and WATER PLANT

OF OPELOUSAS, LOUISIANA.

By A. C. Jones, Superintendent.

This rather intimate relation of the difficulties with the lighting and water works plant of a small Southern city and the methods used in removing them, is by the man responsible for the improvements after the city council saw fit to authorize the work, and shows what can be done with very little, if one has the courage of his convictions and the ability and authority to carry them into practical application. This transformation of a bankrupt institution into a dividend-payer should encourage other municipal and private plants with annual deficits to apply scientific and business principles to their reconstruction and management and pull them out of the "Slough of Despond."

THE electric light and water works plant was installed by Opelousas, La., in 1897 and as first installed consisted of one 110-horse-power center-crank McEwen engine, two 80-h.p. return tubular boilers, one 50-kw. Fort Wayne high frequency alternator, one 40-light Fort Wayne arc machine and 40 open arcs. The water works pumps consist of two 500-gallon Smith-Vaile pumps.

This equipment was kept in service for a number of years and another alternator and engine were installed and the arc machine was discarded and alternating enclosed arc lamps were put in the place of the old open arcs. This equipment gave very good service and the city was able to operate it without serious loss until about 1909, when fuel started to increase in price to a point that meant serious loss unless something was done to decrease the amount of fuel consumed. As soon as the plant started to losing more than the city could afford to lose we found onrselves unable to get enough money to keep the machinery in good repair.

About the same time, the boll weevil destroyed the cotton crop, which was the main dependence of the people round about and almost ruined the principal merchants and the bnsiness of the people generally and this ruin was also felt to a great extent in the falling off of the revenues of the light and water system. At the same time the people voted the parish dry and took the saloon business away from the plant and the saloon licenses away from the city. I spent a great many sleepless nights about this time trying to figure out some way to fix things so that we could keep the plant running without loss or with even a reasonable loss, but came to the conclusion it could not be done with a steam plant. I investigated gas producers and oil engines and came to the conclusion that the only salvation for the city was to install an oil-engine plant. I put the proposition up to the city council but could not get them to even try to do anything. Things kept going worse and worse until the mayor decided that I was to blame for not knowing how to make the steam plant pay, and he employed a consulting engineer to go to the plant when I was not there and look over conditions and report to him. The report was that all was needed was some small repairs that could be cheaply made. I was at the council meeting at which the report was made so I hit the engineer and resigned.

My successor spent $4,000 making the temporary repairs, but kept on losing money so he recommended that the city buy a new steam plant. They finally

bought a tandem-compound 4-valve Fleming engine, direct-connected to a 150-kw. 60-cycle alternator and a 250-h.p. Babcock & Wilcox boiler. This was a first class outfit and the salesman succeeded in convincing them that the fuel bills would be reduced if they put it in, but the results were not much better than they had been with the old plant. By the early part of 1911 the city finances had reached a desperate shape and it seemed that the plant would have to be shut down for good. The receipts from electric and water service were insufficient to pay the fuel bills so that it had become a regular custom to borrow money from the banks to pay for fuel. The employees had to go to the banks and borrow their salaries on their own notes and at the beginning of the next year the city council would pay these notes with interest, out of the license funds.

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¶ RADICAL CHANGES *were required by the conditions into which the plant had lapsed for need of a little money and management at the proper times.*

A new city council took charge of the city's affairs in 1912 and they realized that some radical change had to be made in the electric and water works plant. They finally succeeded in persuading me to again take charge of their plant in July, 1912, and I found things in the most deplorable condition possible. The arc lamps had all burned out and had been replaced by 100-watt Mazda lamps simply screwed into a series socket which was hung up on the old arc-lamp wires, without any attempt at a fixture of any kind. There were no lightning arresters on the wires and every time the lightning would flash it was customary to go to the telephone and see what was burned up so as to get the repairs made before dark. There were always repairs to be made after a storm. The engine and boiler were in good condition but the pumps were worn out. The meters on the electric system were found to be in fairly good condition in spite of the fact that they were 140-cycle meters and the change to 60-cycles has been made without recalibrating them or making any changes in the coils.

The first thing I did on taking charge was to buy 25 Garton-Daniels lightning arresters and put them up. I next grounded the neutral wires on all the secondaries. This cost practically nothing and entirely stopped all trouble from lightning. I was here about a month before I succeeded in getting these changes made and lost over $100 in meters and transformers in that time, and had about fifteen cases of trouble caused by blown fuses in transformers. We occasionally now have reason to know that there is such a thing as lightning, but very rarely, and we seldom lose much by it.

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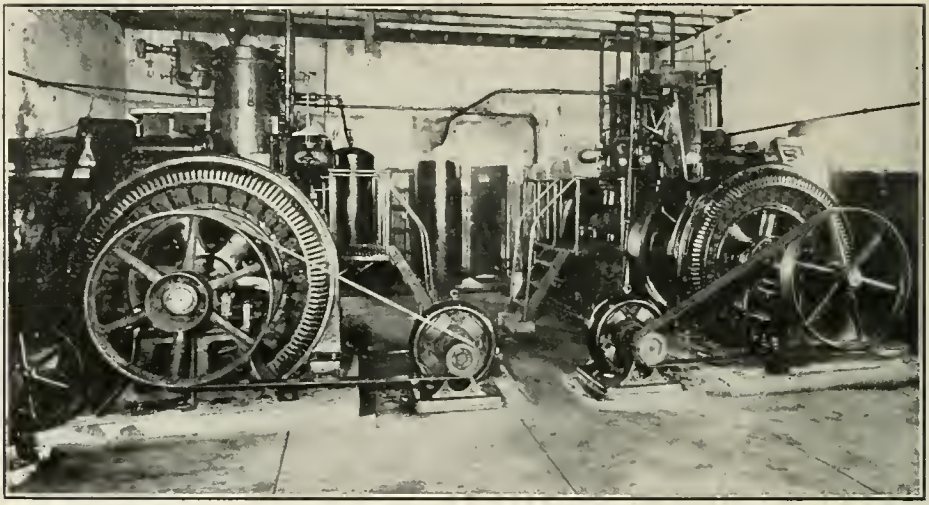
¶ HOW TO MAKE OVER *a plant without money was the problem attacked by the new superintendent.*

The city was in such a deplorable financial condition that the mayor and aldermen were almost in despair. They had to manage in some way to borrow enough money to buy fuel and and also to arrange to install the oil engine plant and the mayor has often said that he didn't know at night where he was going to be able to borrow money enough to get fuel oil to run the next night. We finally arranged to increase the tax rate three mills for two years and anticipated this revenue for two years and managed to borrow $6,000 on it. With this money we bought our first new unit, which consists of one 100-h.p. Mietz & Weiss oil engine, direct-connected to a 100-kva. Fort Wayne alternator, one generator panel, one feeder panel, one 500-gallon Lawrence pump direct-connected by a 35-h.p. 3-phase motor, one 12 by 10 Ingersoll-Rand air compressor with short belt drive from a 35-h.p. 3-phase motor. This installation cost us a little over $11,000. Since we had only $6,000 it was necessary to arrange to pay this out of the money collected from the electric and water service, so we arranged to pay $200 per month, with interest, until this was paid.

This first unit was put into regular service on December 15, 1912. It was



POWER ROOM *of light and water plant of Opelousas, Louisiana, showing Mietz oil engines and dynamos.*

not large enough to carry our peak load, so we had to run the steam plant for about three hours a night, but in spite of this our December report showed a profit of $427.82. There has never been a month since then in which we did not make a profit.

As soon as we could arrange to do so we bought our second oil-engine set, which consists of one 150-h.p. Mietz & Weiss oil engine direct-connected to one 100-kva Fort Wayne alternator, one generator panel and one 300-gallon pump, made by the Lawrence Machine Works and direct-connected to one 20-h.p. 3-phase motor. This installation was completed Jan. 1, 1914. It cost us installed $10,842.00 and left us a debt of $5,842 on this part of the plant, which was to be paid from the revenues of the plant at the rate of $250 per month with 5 per cent. interest.

We are now paying, each month, $450 with interest and in addition to this are paying all labor and operating expenses out of our collections for electric and water service and are furnishing the city in electric light and water service $321 per month in addition to this. We are giving 24-hour service practically the year round and have improved the quality of the service to such an extent that we have reconnected all of the customers who had discontinued the service on account of bad service with the steam plant. Our gross revenues average $150 per month more now than they did under old conditions, principally due to better service, as the new subscribers connected would not account for this increase.

We were somewhat afraid to buy the oil engines for the reason that we were afraid we could not depend upon them to operate the alternators in parallel satisfactorily and so in our contracts with the Mietz & Weiss Company make them guarantee satisfactory parallel operation. They didn't seem to be afraid to have this specified and so we took the chance. On this score there has never been any reason to worry because the two engines parallel very satisfactorily and frequently run together for five hours at a time. The hand-control lever of the Mietz & Weiss engine makes them very easy to get into step and we frequently put these two engines in parallel with only one man in the plant.

We are using the same number of men in the plant that we did with the steam plant. We have a day and night engineer and a night oiler. One man could do the work at night by himself but we do not consider it good policy to leave one man by himself at night when no one is likely to pass thru the plant, and then in

case of trouble two men can prevent a shut down where one can not do so. As far as the work is concerned there is not enough to keep one man busy half the time.

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¶ THE WATER WORKS *plant is an addendum to the electric light plant, very important but easily taken care of.*

The water works system is supplied with water by two motor-driven centrifugal pumps. The water in the well is 42 feet from the surface of the ground so that it is necessary to use an air lift to pump to the reservoir at the plant. This air is supplied by the motor-driven air compressor. We have not been able to find money enough to duplicate this part of the plant but plan to do so as soon as we can. From the reservoir the water is pumped by the centrifugal pumps to an elevated tank located on the court house square, about a half mile from the plant. This tank is 120 feet high and holds 80,000 gallons of water. The water consumption averages about 200,000 gallons per day, but in very dry weather is at times as much as 300,000 gallons.

The population of Opelousas is 5,111.

All water is supposed to be sold only on the meter system but it has been found unnecessary to meter all services and it has been found better to let the superintendent use his judgment as to what is best to meter. The city is not too large for him to keep a fairly close watch on the customers and prevent much waste. Whenever a customer is connected to the sewer system and he could waste much water without it being noticed, he is furnished with a meter. All meters are the property of the city and are furnished without meter rent.

The rate charged for water per 1,000 gallons is:

20 cents where 5,000 gallons per month are used.

19 cents where 10,000 gallons per month are used.

18 cents where 20,000 gallons per month are used.

17 cents where 30,000 gallons per month are used.

16 cents where 40,000 gallons per month are used.

15 cents where 50,000 gallons per month are used.

14 cents where over 50,000 gallons per month are used.

Minimum, 40 cents per month on ½-inch pipe; 50 cents on ¾-inch pipe; 75 cents on 1-inch pipe; 5 per cent. of meter cost on large sizes.

The electrical service is all on meter and the rates are as follows: 250 kw. hr. or less per month, 10 cents; minimum, 50 cents per month on 1 to 10 lights; 75 cents on 10 to 20 lights; $1 on all over 20 lights. A deposit is required sufficiently large to cover the estimated bill before service is started. There is practically no motor load connected except in summer, when the fan business is fairly good.

The December peak load is a little over 100 kilo-watts and the mid-summer peak is about 60 kilowatts.

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¶ THE FINANCIAL RESULTS *are remarkable for a plant in so small a city after a history of poor and expensive service.*

The total receipts for lighting service during the fall and winter amount to about $1,000, and the water service $400 per month. In the spring and summer they amount to $800 for light service and $400 for water service. In addition to this the city pays the plant $321 per month for the street lighting and water service they use. This money is not paid into the treasury of the electric light and water plant until the end of the year so we cannot calculate on paying any of our obligations with it, but have to meet the notes we owe on our oil engines out of our collections for electric and water service.

All meters are read during the last three days in each month and the bills rendered by the first. We use a system of making our bills which we have found works very satisfactorily and which has been copied by several of our neighboring towns. In this system the man who reads the meter enters the reading on the customer's sheet in a specially prepared book into which the last reading of the meter has already been transferred from the previous month's book. The sheet on

which he enters the reading remains in the book as a permanent record. Under this sheet are two sheets on which carbon copies are taken. The second sheet is the receipt to be given when the meter is read. All three sheets are different colors so as to prevent mistakes. When all the bills have been made out, the books are turned over to the city clerk, who is also collector. All bills are payable at the office and failure to pay by the 10th is regarded as sufficient cause for discontinuing the service.

I have gone into the details of our plant frankly and wish to state here that I do not regard our plant as an ideal plant as there are so many things that we lack, but I think that great credit is due to all of us who have been connected with the partial rehabilitation of the electric and water system of this city. Our task at first appeared impossible but we have succeeded in it and will be able after this year to add to the plant all that is necessary, and make the revenues pay for it. The oil engines have enabled us to save about $1,000 per month in operating expenses and have enabled this city to pay almost all of the debts into which the steam plant plunged them. I have done all I could to spread the gospel of the oil engine and I am glad to see that almost all of the new engines that are being installed in South Louisiana are oil engines. I believe that the day will soon come when every user of power will realize that he cannot afford to waste fuel oil by burning it under a boiler when he can save fully seven-eighths of it by getting an oil engine.

City's Proportion of Water Works Expense

The city of Madison, Wis., with the aid of the engineers of the Railroad Commission, has determined the amount which the city should pay for water and the amount which should be collected from the customers of the plant.

The city's proportion is based largely on the capacity of the plant for supplying large quantities of water in a short time (for fire purposes). The first step, therefore, was to separate the $76,840.96 of expense into the portions attributable to capacity and output. All the expenses are charged to capacity but 30 per cent. of pump labor, maintenance of services and meters; 75 per cent. of cost of steam generated; 95 per cent. of lubricants; 50 per cent. of miscellaneous station supplies and expenses; 60 per cent. of maintenance of pump equipment, and 20 per cent. of salaries of general office clerks and of office supplies and expenses, which are charged to output, and $1,580.06 for maintenance of hydrants, fountains and troughs, which is charged directly to the city. This makes 51.92 per cent. of the actual operating expense chargeable to capacity and 48.08 to output. Depreciation, taxes, and interest are distributed in the same proportion..

The Railroad Commission then determined that 49.6 per cent. of the plant was devoted to public use and 50.4 per cent. to private use, being the proportions of the plant devoted to public and private demands respectively. The $39,076.02 of expense charged to capacity was then divided in the above proportions, so that the city should pay $19,381.71 and the private consumers $19,694.31. Adding the direct charge made to the city above, makes its share $20,961.77.

The expense charged to output should be distributed in proportion to water actually used. An analysis of the water consumption showed that private consumers used 93.5 per cent. of the water and the city 6.5 per cent. Thus the $36,-184.88 of expense charged to output should be paid, $33,832.86 by the private consumers and $2,352.02 by the city.

Of the whole expense of operation, therefore, the city should pay $23,313.79 and the private consumers $53,527.17.

Actually the city paid a hydrant rental of $17,200 or $6,113.79 less than its share, and the other consumers paid $60,244.20, or $6,717.03 more than their share. Approximately 10 per cent. taken off the water rates and put on the water used for city purposes or the hydrant rentals would equalize the payments for the year analyzed. Very possibly another year the difference would be much less.

Observation indicates that the city of Madison is paying more nearly its share of the expense of operating its water works plant than the large majority of cities in this country.

REFUSE DESTRUCTOR

AT CLIFTON, BORO OF RICHMOND, NEW YORK CITY.

The new refuse destructor for the Clifton district in the Boro of Richmond, New York City, has now been in operation long enough to demonstrate that it is even more successful than the plant of the same general design which has been operated for several years in the West New Brighton district of the same boro, and this brief description, taken mainly from the latest report of the department having the destructors in charge, will serve to indicate the points of advantage in this later design.

THE boro of Richmond, of the city of New York, has added to its facilities for the disposal of garbage and refuse a new destructor furnace at Clifton. The first destructor in the boro, of the Heenan high-temperature, mixed-refuse type, was built in 1907-8 in the West New Brighton district and had a capacity of 60 tons a day. This plant was so successful that the new plant, built in 1913, is of the same type and has 90 tons capacity. The boro of Richmond occupies Staten Island, in New York Bay, and has three main groups of habitations, two of them served by the West New Brighton and Clifton plants, and a third, Tottenville, to be served by a smaller plant to be installed shortly.

The West New Brighton plant and its operating results have already been described in several articles in MUNICIPAL ENGINEERING and it is only necessary to state that its success is continuing. The five years of operation of the plant have shown its advantages and disadvantages, which are thus stated in the latest report of J. T. Fetherston, who constructed and has operated the plant until his recent promotion to the position of Commissioner of Street Cleaning in the boro of Manhattan:

"The plant was operated without complaints of nuisance in a locality where odors would certainly result in serious legal complications.

"By-products, steam and clinker, were obtained, the sale of which would decrease the cost of disposal if existing laws did not prevent their advantageous utilization, the value of the excess steam alone being estimated at $4,500 per annum.

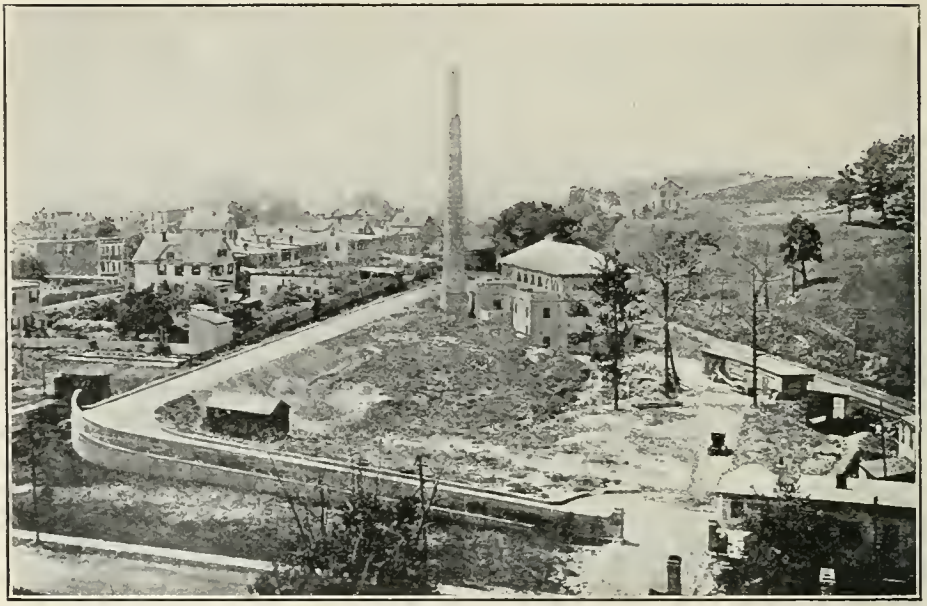
"The work of the furnacemen was very arduous and should be reduced in future installations."

In preparation for the final detailed design of the Clifton plant, and after the contract for it had been awarded to the Destructor Company in 1911, a small experimental furnace was erected to try out mechanical means of charging and clinkering the furnaces. The result is a reduction in the arduous labor heretofore attendant on those two operations and a decided reduction in the cost.

The charging of the furnace is done by a pan with a movable back or pusher, opposite each furnace door, which is forced into the furnace by a hydraulic ram so as to cover the grate completely. The pan is then withdrawn, the pusher remaining stationary, and the refuse is thus shoved onto the grate in the same relative position it occupied in the pan.

The clinker is broken up by the movement of a flat grate with two ridge bars, attached to a hydraulic ram, and allowed to drop into the cooling chamber below, from which it is pushed by another ram. The clinker falls into a bucket, where it is cooled by water and is then crushed in a roller crusher, elevated, screened and stored in hoppers for removal by carts.

There are two 45-ton furnaces in the



NEW NINETY-TON HEENAN *refuse destructor for the Clifton district, Boro of Richmond, New York City, and its surroundings, showing no fear of nuisance from its operation.*

Clifton plant with two 150-h.p. boilers, one 50-kw. electric generator, hydraulic pump, accumulator, clinker crusher, and appurtenances.

As the Clifton plant is scarcely a year old, official figures of operation for a year are not yet available, but the official tests of the plant are on record and can be compared with the earlier tests, in 1908, of the West New Brighton plant. The amount of refuse burned per square foot of grate surface per hour was nearly three times as great in the new as in the old plant, being from 139 to 147.2 pounds, as compared with 49.6 to 62.7 pounds. The residual clinker, ashes and dust is somewhat less, being 26.5 to 42.5 per cent. of the weight of the original refuse, as compared with 30.2 to 41.2 per cent. The evaporation of water in the boilers per pound of refuse burned was also less, being 1.00 to 1.11 pounds, as compared with 1.10 to 1.41 pounds in the old plant. Temperatures were slightly less, the averages in the combustion chamber being 1,657 to 1,664 degrees F. in the new plant, as compared with 1,637 to 1,846 in the old. Maximum temperatures showed more difference, being 1,830 to 1,900, as compared with 1,904 to 2,210.

Nearly twice as many fires were clinkered during the tests of the new plant as during like durations of tests in the old plant, as might be expected from the more rapid combustion in the new plant. The average time of clinkering with the mechanical apparatus of the new plant was usually about one minute, 57 to 60 seconds, tho in one test it was 3 minutes, 9 seconds. The average time of clinkering in the five tests of the old plant with hand labor varied from 8.2 to 12.3 minutes. This reduced the percentage of time the furnace doors were open from 73.7 in the old plant to 5.1 in the new.

Refuse burned amounted to 1,357 pounds per furnaceman per hour in the old plant, and 3,330 in the new, and the cents per ton in the old plant and 41 cents in the new.

During the official tests of the new plant the cost of incineration per ton of refuse burned was from 40 cents to 41.8 cents per ton. The total annual cost of incineration in the West New Brighton destructor has been from $1.23 per ton

in 1909 to $1.37 in 1912. If the difference in total cost is the same as the difference in cost of plant operation in the trial, the total cost in the new plant will be somewhat less than $1.00 a ton. If this proves to be true, the trouble and expense of experimenting with the mechanical operation of the furnace will be fully justified. Mr. Fetherston's report does not make the above definite comparison, being satisfied with the statement that "the operating cost at Clifton has been decidedly reduced, tho some time must elapse before the complete economy of the mechanical devices is demonstrated."

Another pecuniary advantage of the high-temperature mixed-refuse destructor is found in the statement that the cost of collection of mixed refuse for the West New Brighton destructor was 10 cents per capita per annum less in 1912 than was the cost of separately collected refuse and garbage in 1904, a saving of about $7,500 a year in the two districts of West New Brighton and Clifton, which Mr. Fetherston credits to the operating of the high-temperature destructor.

Municipal Ownership in Belfast, Ireland.

During the fiscal year ended March 31, 1913, the municipal gas works of Belfast, Ireland, made 2,480,628,000 cubic feet of gas, of which 1,389,231,000 cubic feet were coal gas and 1,091,397,000 cubic feet water gas. This was an increase of 142,105,000 cubic feet over 1911-12, when 1,224,282,000 cubic feet of coal gas and 1,114,241,000 cubic feet of water gas were made.

The cost of producing gas in 1912-13 was $616,219, against $633,933 in 1911-12, and the receipts from sales were $1,024,113 in 1912-13, against $971,383 in 1911-12. From the profits, $54,406 in 1913 and $54,263 in 1912 were contribnted to the sinking fund of the city hall. In addition a grant of $48,665 was made each year in aid of city taxes. The following figures show the results obtained at the plant:

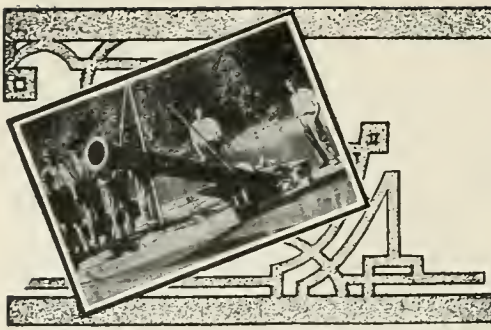
	1911-12	1912-13
Gas made per ton of coal, cubic feet	11,869	12,201
Gas made per ton of oil, cubic feet	116,211	128,001
Gas made per ton of coke, cubic feet	53,711	53,909
Oil used per 1,000 cubic feet, gallons	2,288	2,027
Works cost of gas per 1,000 cubic feet, cents	19.998	17.858
Cost of gas per 1,000 cubic feet, cents	26.738	24.502
Proft per 1,000 cubic feet, cents	14.232	16.218

The present selling price of gas is 2s. 3d. (54.7 cents) per thousand cubic feet with a discount of 20 per cent. for payment within one month from date the account is furnished. Early in 1913 new equipment, including sets of vertical retorts, a large gas holder and a coke-handling plant, was installed, increasing the maximum producing capacity of the plant from 12,140,000 cubic feet to 14,640,000 cubic feet in twenty-four hours.

During 1913 the new abattoir for the Belfast city corporation, said to be one of the most up-to-date in the United Kingdom, was formally opened and it is now in full operation. Private slaughter-houses inside the city have been abolished, but there are still a number on the outskirts. Over these the inspecting officials of the corporation have no control, tho they exercise full power of inspection over the meat brought in from them.

The water supply of Belfast is drawn from three sources, supplying daily about 23,500,000 gallons of water. The present storage capacity of reservoirs is 2,525,000,000 gallons. Plans are being drawn, however, for the construction of a reservoir that will have a storage capacity of 3,000,000,000 gallons, the estimated cost being $1,459,950.

The total income of the water commissioners for the fiscal year ended October 31, 1913, was $574,701, as against $554,241 the preceding fiscal year; the expenditures for the two years were $569,140 and $530,430, respectively.



EDITORIAL

EUROPE'S MADNESS OUR OPPORTUNITY.

Unquestionably the European war which has struck us so suddenly is the result of the rampant militarism fostered and advanced under monarchical institutions and put into action by those who still have power of life or death over their subjects at least to the extent of sending them to war. It is to be hoped that this is the death-struggle of militarism and that hereafter the economic problems of the world will be worked out without appeal to passions and prejudices. Meanwhile the people in the countries at war, willingly or unwillingly, fighting for or against the maintenance of the anachronisms in control are losing their hold upon the business of the world, and if the war continues, will find their trade gone elsewhere if any one wants it. This is due to the fault of the leaders and their inability to settle the problems of peace in a peacable way, and is the misfortune of the people.

We cannot rejoice over misfortunes but we will fail in our duty to those cut off from their usual sources of supply as well as to our own best interests if we do not step in and fill, from the wealth of our present possessions as well as the prospective product of our possibilities, the needs of those who are dependent, from the nature of their conditions, upon other nations for their supplies of manufactured products and of prepared food supplies.

In the past the manufacturers in the United States have seemed to care little for foreign trade. If it was forced upon them it was taken with pride perhaps but as a wholly fortuitous circumstance. Trade has been prevented by unwillingness to study the conditions of markets and to meet their demands and has been killed by almost criminal carelessness in handling every detail from the original letter or catalog to the collection of the bill.

On the other hand, purchasers have been encouraged in their peculiarities by traders from other countries, who humor them because they see in this a way of turning the American independence of such conditions against itself and thus preventing or killing the competition from this country.

Under war conditions the purchasers can hardly be as strenuous in their adherence to old and useless customs, and if the manufacturers of the United States will treat the trade with ordinary fairness as to quality of goods, security of packing, allowance for damage in transportation, use of agents in the countries dealt with, so as to enter into as cordial and equitable relations with it as they maintain with their customers at home, the export trade will jump at once into full growth.

The new banking system will make exchange with other countries easier. The proposed new navigation laws and aid of the government in starting the new lines of transportation made necessary by the destruction of the old, will make transfer of goods easier and less expensive. They will put American freight on vessels controlled by its friends instead of those interested in the development of freight business from other countries, thus removing large opportunities for accidents and delays for which it has been difficult to determine the causes, but which were almost always in the interest of foreign shippers.

With all the handicaps removed at once, the manufacturing interests of this country should feel immediately the impetus of the new demands and should see their trade increase by leaps and bounds. Individuals need do no more than their share in catering to the new trade, in such manner as has been suggested above, to reap their share of the golden harvest.

Municipalities and states will make their full demands and their trade is even more stable than that of private individuals and corporations, so that the readers of and advertisers in MUNICIPAL ENGINEERING should profit in more than average degree from the new conditions. This magazine has many connections with the countries whose trade with the United States is to be developed, thru correspondents, agents, and subscribers, and can and will do its full share in turning the stream of trade this way and keeping it in the new channel.

BOATS FOR THE NEW YORK BARGE CANAL.

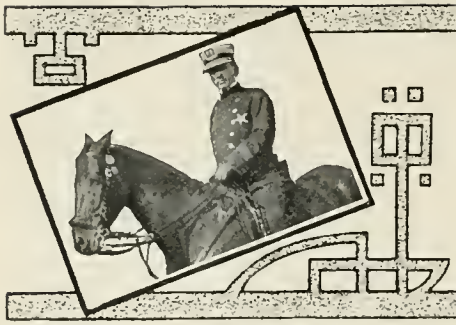
One of the problems having much influence in determining the value and the economy of a canal across the state of New York is the size of boat. This was considered in a general way during the discussion of the plans for the enlarged Erie canal, but is now up for definite solution.

A steamer satisfying Federal Government requirements for navigating the lakes cannot be designed to suit the 15½ feet clearance overhead, the 12 feet depth and 75 feet width, which are the limitations of the canal.

State Engineer Bensel suggests that the popular size will be 150 feet by 22, four in a string, as the locks will carry four, one to tow the other three. Boats 300 feet by 40 to 43 feet and 250 by 35 to 40 can be used on the lakes also, but would require passing basins on the canal, and very slow speed around curves. A 50-foot tug could tow one larger and one smaller barge in the canal and larger tugs could tow fleets of them on the lakes and Hudson river.

The state must determine the maximum sizes and prepare the canal for them before the new canal is put in full operation. Will the contention that the canal is too small for economical operation in connection with the waterways at both ends be proved correct?

A special investigation by one manufacturing firm showed it would not be desirable to tranship at any intermediate port and boats must be designed for cheap and rapid unloading at warehouses and ocean vessels. They must use the larger sizes of barges noted, with tugs, if the state will equip the canal so that they can be handled.



QUESTION DEPARTMENT

Building Ordinance for Small City

We would like to get a copy of what you consider the best building ordinance, both for fire district and for residence or wood building district, more especially fire ordinance, for a growing, up-to-date tourist town on the coast, with about 10,000 population, many apartment and rooming houses, small and large hotels and boarding houses.

N., Commissioner of Public Safety,
————, Fla.

We want to get some regulation here on buildings and I am writing you to see if you can give me any information that will enable me to write an ordinance, or can get me a sample ordinance. M., City Engineer,
————, Pa.

A recent publication of the National Board of Fire Underwriters 135 William street, New York, and the National Fire Protection Association, 87 Milk street, Boston, gives a "Code of Suggested Ordinances for Small Municipalities," including regulation of fire limits and building construction, automobile garages, picture machines and premises, inspection of premises by fire department, clearing streets of refuse, burning of refuse, storage of explosives, fireworks and fire escapes.

These forms of ordinance can be modified readily to fit local conditions and can be obtained upon request from either of the organizations named. To show the scope of the building and fire-limit ordinance the following titles of sections are given:

1. Fire Limits; defining them.
2. Permit Required; for building, enlarging, altering or moving.
3. Incombustible Walls, Cornices and Roofs Required Within Fire Limits.
4. Permissible Wooden Structures Within Fire Limits; temporary one-story, certain described one-story sheds, fences, piazzas or balconies, bay-windows, small, low outhouses, grain elevators, coal pockets, ice houses, all as described and under limitations set.
5. Repairing Frame Buildings Within Fire Limits; not permitted if fire has destroyed more than half its value, exclusive of foundation.
6. Buildings Having Prohibited Occupancies Within Fire Limits; including public garage, coffee roaster, bakery, dry-cleaning establishment unless fireproof.
7. Limits of Height and Area; to 3 stories for hollow terra cotta or concrete blocks; to 4 stories unless fireproof; to 10 stories for any building; of floor area between fire walls.
8. Walls; thickness, materials, fire walls, brick, reinforced concrete and stone walls, party walls, hollow block walls, compressive strength of blocks, lath and plaster.
9. Concrete Construction; proportions, design and construction.
10. Protection of Ends of Wooden Beams; in party or fire walls.
11. Protection of Wall Openings; in interior walls; fire doors, shutters, wired glass windows, closing of fire doors, shutters and windows.
12. Stairway and Elevator Shafts; separation, enclosures, fire doors, trap doors.
13. Skylights over Stairway and Elevator Shafts; incombustible frame and sash, glass, screen.
14. Floor Lights; glass in metal frames.
15. Light, Vent and Dumbwaiter Shafts.
16. Roof Covering; incombustible; renewal of shingle roofs damaged over 25 per cent. prohibited.
17. Roof Openings.
18. Exits Required; doorways, elevators, stairways.
19. Fire Stops.
20. Areaways.
21. Frame Buildings; not over two stories except private dwellings three; no frame building over 7,500 square feet if one-story or 5,000 if two, except grain and coal elevators and pockets, ice houses and exhibition buildings; none within 3 feet of lot line or 6 feet of another building without 2½ inches of brickwork or equal incombustible between; dividing walls in rows of incombustible material with metal lath; metal or brick veneer does not change classification as frame; brick buildings outside fire limits may be varied by permission from strict requirements of brick buildings in the ordinance.

22. Electrical Installations; according to National Electrical Code.
23. Chimneys and Fireplaces; detailed restrictions.
24. Wooden Beams Separated from Masonry Chimneys.
25. Smoke Pipes; thru or near partitions, floors or roofs, how protected.
26. Hot Air Pipes and Registers; thru floor or partitions, how protected, registers, register boxes, cold-air ducts incombustible.
27. Steam and Hot Water Pipes; not within one inch of woodwork; thru floors, ceilings or partitions protected.
28. Dry Rooms; if over 125 degrees F. must be lined with incombustible as described, with wire glass windows.
29. Stoves and Ranges; proximity to walls, shields, hoods, floor protection.
30. Heating Furnaces and Appliances.
31. Open Flame Heating Devices.
32. Gas Connections; metal pipes; portable heaters.
33. Vent Flues.
34. Safety of Design; as to loads to be carried.
35. Duties of Enforcing Officer.
36. Penalty for Violations.
37. Conflicting Ordinances Repealed.
38. Date of Effect.

The city of Indianapolis, Ind., had a new ordinance passed in November, 1913, which goes into great detail, so that the official publication of the ordinance required eight solid newspaper pages of six-point type.

Its parts each include several sections and the titles include:

1. Building Code; covering organization of office, 15 sections.
2. Definitions, 1 section.
3. Fire Limits, 1 section.
4. Preliminary Requirements; permits, fees, inspections, arbitration, bond, 16 sections.
5. Classification of Buildings, 9 sections.
6. Quality of Materials, 8 sections.
7. Loads and Floors, 5 sections.
8. Excavations, 4 sections.
9. General Conditions, going into details of construction, 48 sections.
10. Skeleton Construction, 5 sections.
11. Reinforced Concrete Construction, 43 sections.
12. Concrete Block and Massive Concrete, 14 sections.
13. Stairways, 5 sections.
14. Theaters and Places of Amusement—Classification and Construction, 77 sections.
15. Fireproof Shutters and Doors, 7 sections.
16. Chimneys, Flues and Stacks, 12 sections.
17. Furnaces and Heating Plants, 14 sections.
18. Livery and Feed Stables and Garages, 6 sections.
19. Storage of Oils, 4 sections.
20. Restricting the Manufacture and Handling of Calcium Carbide and Products Thereof, 2 sections.
21. Cellars, Water System, Rotary Nozzles—Inspection of Cellars, 7 sections.
22. Signs, Sign-Boards and Bill-Boards, 17 sections.
23. Smoke—Smoke Inspector, 8 sections.
24. Elevators, 24 sections.
25. Electric Wiring for Light, Heat and Power, 47 sections.
26. Penalties—Repeal, 3 sections.

This ordinance has much more than would be required in the small cities making the inquiries, but the general plan of the ordinance could be followed, omitting unnecessary sections.

Cleveland also has an excellent building ordinance which fills a good sized book.

Compulsory Connections With Sewers

We are about to pass an ordinance condemning all cesspools, etc., and compelling connections to be made to the city sanitary sewer, and would like to know of other towns and villages who have gone thru this and just how far they were able to enforce such an ordinance. Any references to legal decisions which you can give us will be doubly appreciated.

S., Sewer Commissioner.
———, Neb.

This is one of the first questions which arises when a sewer system is constructed and its answer depends upon local conditions almost entirely. For this reason we ask our readers to report their experiences for the benefit of the inquirer.

It is assumed that there is a public water supply. One method is to require a sewer connection from every lot on which city water is in use. This is done by ordinance, or in some cases by regulations adopted by the board of health under the general sanitary ordinance or the city charter. In larger cities connections may be required from every lot, especially if wells have become polluted and are condemned so that connections with the city water supply are forced by lack of other water.

This is done more easily if the water supply is owned by the city, such ordinances often bearing the suspicion of being passed for the benefit of the water company in case of private ownership, especially in small cities where the dangerous character of well water supplies has not yet shown itself strongly.

In one city the ordinance provision is as follows, the water supply being in the hands of a private company, well water not above suspicion but still in general

use, and the city in the process of constructing a sewer system:

"The common council, upon the completion and acceptance of any public sewer, shall direct the mayor to give thirty days' notice to the owners or tenants of all hotels, restaurants, boarding houses, drinking saloons, hospitals, or infirmaries, having a frontage on the street wherein such sewer is laid, that they will be required to make connections with such sewer, under the provisions of this ordinance. All persons who shall fail to comply with the requirements of such notice within thirty days after such notice shall be served upon them, upon conviction before the police judge shall be fined in any sum not exceeding one hundred dollars."

Another aid in inducing the making of sewer connections will be found in strict regulations of dry closets, cesspools, vaults and the like, some of which will be found in MUNICIPAL ENGINEERING, vol. xxxviii, p. 37. If these regulations are made sufficiently strict to insure perfect sanitary conditions and the cost assessed for carrying them out is made large enough to pay all the expenses, it will usually be found cheaper to use city water and put in the sewer connections, and thus the property owners or tenants will find it to their interest to make the connections.

The ordinance above quoted may be made to apply by adding residences and all producers of waste removable thru sewers to the list of buildings to which it applies. Possibly it will be necessary to add the proviso "connected with the public water supply," or "having a sufficient water supply in the opinion of the board of health." There seems to be no question that the board of health has the power to abate nuisances and charge the cost on the persons or property responsible and the only questions are as to methods. These differ according to the laws and city charters in the various states and advice should be obtained from the city attorney or others conversant with the laws of the locality as to the advisability of any certain method of procedure.

Among cities cutting off the use of cesspools on all streets as rapidly as they are supplied with sewers are the following whose methods of taking care of right soil are reported in MUNICIPAL ENGINEERING, vol. xxxv, p. 8.

Somerville, Holyoke, Springfield, Mass.; Pawtucket, Providence, R. I.; Hartford, Conn.; Hoboken, Elizabeth, N. J.; Harrisburg, Pa.; Augusta, Ga.; Seattle, Tacoma, Wash.; Los Angeles, Cal.; Milwaukee, Wis., which carries on a fairly regular campaign of condemning vaults; Albany and Troy, N. Y., the latter operating under orders of the board of health.

Not all cities have as definite powers as are conferred on the city councils of certain Indiana cities by the following charter provision, but most of them have almost equal powers under the sanitary laws of their states and the general powers granted them by legislative enactments:

"To declare what shall constitute a nuisance, to prevent the same, require its abatement, authorize the removal of the same by the proper officers, and provide for the punishment of the person or persons causing, continuing or suffering the same to exist, and to assess the expenses of its removal against such person or persons and to provide for collection of such expenses either by placing the same on tax duplicate or by suits."

Expansion Joint in Alley

Is it customary or necessary to use expansion joints in a brick pavement in an alley intersection? The alley is 16 feet wide and 26 feet long from curb line to property line. I am a graduate engineer and a paving contractor. H., ————, Ind.

The description is of an alley wing within the limits of the street which the alley enters and between the street pavement and the street property line. If this is correct, it may be said that it is customary to carry the expansion joint along the gutter of the street pavement across the alley intersection, but not to put an expansion joint in the alley wing pavement proper.

In locating expansion joints in such appurtenances to the pavement proper, insufficient attention is paid to the local conditions and so their success from the point of view of the prevention of expansion is problematic.

Altho traffic must cross thru the gutter in passing from the street into the alley, the gutter is preferable to a crowning of the alley pavement so as to meet the crown of the street pavement, because this crowning of the junction of alley and street inserts a weakness in the line of the longitudinal expansion of the street and may cause bulging of the street at the alley intersection in the same way as that occurring at street intersections which are not properly designed.

Usually it is desirable to pave alleys lower in the center than at the sides rather than to crown them, as this carries the drainage in one line to the street gutter and without special preparation of gutters for the alley. This makes it easy to flatten out the cross section of the alley to meet the fixed straight line of the street gutter.

The expansion tendency of the alley pavement is thus prevented from bulging that pavement and longitudinal expansion joints are not necessary in an alley or street paved with such a cross section.

Any slight expansion in the 8 feet of the half alley width is resisted by the material of the pavement itself or pushes the margin of the pavement out slightly.

This method of construction is likely to produce a step down on each side from the sidewalk to the alley surface, which may be reduced by carrying the alley pavement out as high as possible to a point near the street gutter and then dropping its surface by as steep a grade as is practicable to the level of the street gutter. This produces a rather objectionable depth of gutter for traffic to pass across in going from street into alley and an adjustment of demands should be made so as to make the surface as satisfactory as possible. At the change of longitudinal grade of the alley which is likely to take place either at the edge of this gutter or at the property line of the street, there is an opportunity for longitudinal expansion to produce a bulge in the alley pavement. If this change in longitudinal grade takes place where the cross-section of the alley is concave upward, the conditions are rather complicated and it is probable that no expansion joint would be needed. If it takes place where the alley cross-section has been flattened out, bulging is liable to occur. The writer is disposed to think that an expansion joint in the alley intersection or at the property line is not the cure for this tendency to bulge, but that it might tend to emphasize it. A better safeguard would be a heavy marginal curb, deep enough and strong enough to prevent the expansion and cause it to be taken up by internal stresses in the pavement itself.

Who Design and Build Electric Lighted Fountains?

This city has under contract, under my direction, the construction of a lakeside public park, including shell walks and roads, public comfort stations, drinking fountains and ornamental water fountains, among which latter is proposed a large reinforced prismatic fountain, electrically illuminated. This fountain will consist of a large pool or basin approximately 75 feet in diameter, several centrally located superimposed basins, surmounted by a fountain head and 6 or 8 smaller fountain heads arranged in the large pool.

So far I have been unable to get any data on the design of a fountain of such magnitude, especially on the feature of the prismatic illumination by electricity, and I would therefore appreciate your assistance or suggestion in the matter of design, covering the construction of the above described fountain.

B.

Can our readers refer our correspondent to designers or manufacturers of such fountains? Application to the management of the great expositions, especially at the present time to the superintendents of construction of the Panama-Pacific Exposition at San Francisco and the Panama-California at San Diego should put the inquirer in touch with experts in this line, as both will use them.

Rates for Public Utility Services

Will you kindly furnish me with information, pro and con, in regard to public utility companies' rates.

B., Mayor,
————, N. C.

The "Manual of American Water Works" ($1.50) for 1897, gave a full table of rates for private and public water service, which is of course somewhat out of date as to many cities. The most comprehensive recent list is in the Journal of the American Water Works Association, 2419 Greenmount Ave., Baltimore, Md.

Electric light and gas rates are given in more or less detail in Brown's Annual Directory of American Gas Companies ($5) and McGraw's quarterly "Electrical Directory" ($10 a year).

Trigonometric Tables of Grads

I want to find out if possible where I can obtain tables of natural and logarithmic sines, cosines and tangents of grads (400 grads = 360 degrees).

L., ————, Conn.

If the writer's memory is not at fault such a book dividing the quadrant into 100 parts in conformity with the metric system was printed in France many years ago and can possibly be obtained thru importers, such as D. Van Nostrand Co., or G. E. Stechert, New York. During the present difficulty of communication with European countries, possibly some reader can locate a copy of the tables in this country that can be obtained by our correspondent.

Unloading Tank Cars of Road Bitumens

Can I get from you a circular describing the unloading devices for unloading tarvia and oils from tank cars into wagon tanks, or tell me where I can get information.

H., ————, Ariz.

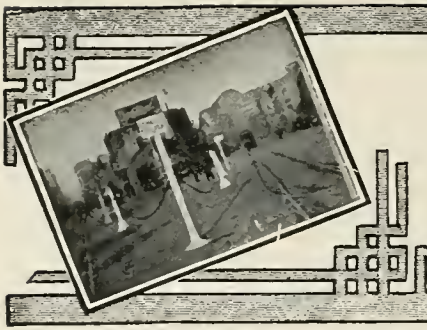
There is no regular manufacturer of such apparatus known to the writer. An illustrated article on the subject is in preparation but is not ready to appear in this number of MUNICIPAL ENGINEERING.

Makers of Metal Street Signs

Will you give us the names of manufacturers of metal signs for street names and to limit speed of automobiles?

R., ————, Pa.

The Curtis-Ward Co., 28 E Jackson St., and the Enameled Steel Sign Co., 222 N State St., both in Chicago, Ill., are makers of such signs.



WORKERS IN THE FIELD

Burned Asphalt Quite Unnecessary

The Editor of MUNICIPAL ENGINEERING:

Sir—I have read with much interest the articles under the heading "Burned Asphalt Can Be Prevented," on page 49 of your July issue, and page 125 of your August issue. Apparently the article in the July issue was written by someone interested in the building of asphalt paving plants of a special type providing for steam heating the asphalt cement. The name of the writer is not given. The article makes a statement to the effect that with steam at 125 pounds pressure the asphalt cannot exceed 350 degrees. This statement is absolutely true. Mr. Hetherington, who is interested in another type of asphalt paving plant, picks this up and says: "But the real question is this: Can you obtain 350 degrees of temperature from steam at 125 pounds pressure without outside assistance from another source of heat?" and adds: "The Fahrenheit temperature of steam at a boiler pressure of 125.3 pounds is 352.8 degrees. Inasmuch as it is a well-known fact that a very considerable percentage of loss is occasioned between the boiler and the melting kettle, it is difficult to understand how you can obtain 350 degrees temperature in your asphaltic cement from steam at 125 pounds boiler pressure."

This statement is also doubtless technically true, but practically it is not at all necessary to heat true asphalt cement to 350 degrees Fahrenheit. While high-grade asphalts are not injured at 350 degrees, it is safer not to heat them above 300 or 325 degrees Fahrenheit, a temperature which certainly can be attained by steam heat.

The writer of the earlier article says: "All asphalt coming in contact with the part of the melting kettle nearest the fire is burned in spite of any agitation given it." Mr. Hetherington picks this up and, without stating that the alternatives which he suggests are those adopted by him in his special form of asphalt plant construction, says that the trouble can be overcome by either:

1. "Asphalt melting kettles have been superimposed over the settings of sand heaters in such manner that the surplus heat from the fires of the sand heaters acted upon the shells of the kettles from below and thus formed heating means auxiliary to steam melting coils arranged upon the insides of the kettles."

The serious objection to this method is that it is a complicated construction, not only making it extremely difficult to make repairs to either kettles or sand heaters, but also increases the expense of operation and the danger of serious fire when the time comes, as it always will come sooner or later, that the kettle leaks; also, if the asphalt cement in the kettle becomes too hot it is liable to further injury from the heat of the dryer fire, which cannot be shut off without closing down the entire plant.

2. "Separate the fires from the kettles by interposing walls so that burning of the asphaltic material is practically impossible if the melting operations are under the charge of an ordinary intelligent operative."

The objection to this method of construction is that it is unnecessarily complicated and expensive and does not allow the kettle to utilize the heat from the fire to the fullest extent.

Referring further to the statement quoted above by the writer of the article in your July issue to the effect that, if the bottoms of the melting kettles are subjected to direct heat or, as he expresses it, "with furnace heat applied to the exterior of the kettle at a temperature of at least 1200° F.," the asphalt cement is necessarily burned—that is absolute "buncombe."

The above statement is very misleading. Of course, it means that the temperature of the furnace flames or gases is "at least 1200° F." but as written would lead the average layman to believe that the metal of the kettle bottom was that hot, which, of course, is impossible, unless the kettles have been allowed to collect an abnormal coating of sediment and coke.

It is safe to say that as long as any liquid asphalt cement can reach the kettle

bottom the metal is never more than 20° F. hotter than the asphalt cement at top of the kettle.

Far hotter fires are regularly used under the ordinary stationary steam boiler than under any asphalt kettle, yet no one would suggest that the water in any part of the boiler approximated 1200° F.

The writer has had practical experience for more than thirty years in the handling of refined asphalts and asphalt cements in the laying of asphalt and other bituminous pavements, in all departments, from foreman of an asphalt refinery and asphalt paving plant up. He can show pavements, still in good condition, under unusually favorable physical conditions of use, having required remarkably little repairs, laid as far back as thirty years, particularly Alexander street in the city of Rochester, N. Y., in connection with which he was foreman of the paving plant. He has had direct charge of the laying of millions of square yards of asphalt and other bituminous pavements under all conceivable traffic and climatic conditions, varying from Canada to Texas. While he has operated paving plants, the kettles of which were provided with steam heating coils, and also with the devices described by Mr. Hetherington, the great bulk of the work referred to has been done with plants in which the fire (whether wood, coal, natural gas, or oil) comes in contact with the kettle bottom and he has never been able to observe that, with reasonable care, there has been practically any more trouble from overheating the asphalt cement by one method of heating than another. He can certify that, with reasonable care, it is a very extraordinary thing to injure asphalt in the process of melting. Without the exercise of due care the asphalt may be over-heated by either of the methods described by Mr. Hetherington.

It is not even technically true that "asphalt coming in contact with the part of the kettle nearest the fire is burned." It is, however, a fact that the impurities in an asphalt, if any, will, to a greater or less extent, settle to the bottom of the kettle and, to a slight extent, become coked to the kettle bottom without injuring the asphalt cement. Under such conditions, when a kettle is emptied and cleaned, it is found that there is coke to the extent of possibly one-quarter inch or more on the kettle bottom next to the fire. The fact is, that, with reasonable care with any of the accepted methods of heat application to asphalt kettles, there is no more danger of over-heating asphalt than there is of burning potatoes when boiled in the ordinary vegetable pot. If the cook permits the water to boil away, the potatoes next to the bottom quickly burn. In the melting of asphalt cement, as soon as the material next to the kettle bottom becomes fluid and hotter than the material above it, it has a lower specific gravity than the cooler material, naturally rises and produces a circulation in the asphalt cement, the cooler material taking the place of the hotter material which has risen, just as in a case of heating water. So in the heating of asphalt; so long as the material is not heated to a temperature approaching that at which the lightest of the component oils are vaporized, the asphalt is not being injured, provided it is not kept hot for an unduly long period. Of course, the circulation should be increased by artificial agitation either by steam, air or mechanical means, but this agitation is for the purpose of:

1. Retarding the settlement of foreign mineral matter to the bottom of the kettle.
2. Facilitating the melting and heating up the lumps of cooler asphalt, which is much more rapid under artificial agitation than if left entirely to circulation by gravity referred to above.
3. Facilitating the combining of the refined asphalt with the fluxing agent, which is generally placed in the kettle at the same time as the refined asphalt. As soon as the asphalt is melted and the fluxing agent and refined asphalt are combined, it is desirable to suspend agitation, unless the asphalt is of a character which contains such a large percentage of mineral matter as to require continued agitation to prevent excessive settlement.

Quoting from Mr. Hetherington: "There is no more reason why the asphalt should be burned than there is that the water should be permitted to get too low and the boiler explode" and that without the adoption of the special devices of this or that plant manufacturer which have practical disadvantages far outweighing the actual advantages produced by such devices.

It happens, with entirely too great frequency, that men who have practical experience in the different branches of the asphalt producing and paving field and who are, therefore, "experts," make public references as "advantages" to certain characteristics contained in the materials in which they are interested, or certain devices which they have adopted, which are really nothing more than commercial talking points and should not be presented to the public in the form of references of "experts" to important characteristics. Would that such practical experts would confine their public expert utterances to points of real practical importance and withhold their commercial propositions for commercial argument and not present them as free expert testimony for public consumption.

GEORGE C. WARREN.
Boston, Mass.

Philadelphia's Second Clean-Up Week

The Editor of MUNICIPAL ENGINEERING:

Sir:—Believing that you might be interested in the operation and the results of Philadelphia's second annual clean-up week, I present a comprehensive report on the preliminary advertising and the results obtained.

In conducting Philadelphia's second annual clean-up week, April 20 to 25, this year, a committee of three men, representing the Bureau of Highways, the Bureau of Fire and the Bureau of Health, was appointed by the mayor to take charge of the work done under the supervision of the city officers.

The members of this committee were: Mr. John Neeson, Assistant Engineer of Bridges and Sewers, Bureau of Highways, (Chairman); Mr. Joseph Mallory, Fire Marshal, Bureau of Fire, and Mr. R. Robinson Barrett, Chief Inspector of Nuisances, Bureau of Health.

Shortly after the appointment of this committee, the Chamber of Commerce and the Merchants' and Manufacturers' Association of Philadelphia ,appointed a large representative committee of citizens, to cooperate with the city committee in order to conduct a successful campaign. This committee was divided into twelve sub-committees, to-wit: Finance, press, poster and printed matter, trade associations, community associations, charitable and benevolent, school and school children, churches, retail stores, street cars, vacant lots and fire prevention.

Persons on this citizen's committee are all prominent business men and men interested in civic activity in Philadelphia.

In order that every citizen might know the date and the object of clean-up week, and in order that they might give their best cooperation, a very extensive and most effective advertising campaign was entered into.

The director of the Department of Public Works sent out 3,400 personal communications to the following:

(a) All advertisers and advertising agencies, manufacturers of brushes, brooms, buckets, vacuum cleaners, and, in fact, to every concern manufacturing any kind of an article used for cleaning.

(b) All women's civic organizations; civic club, home and school league, literary, etc.

(c) All business men's organizations.

(d) All theater managers.

(e) Managers of moving picture houses.

(f) All real estate agents.

(g) All banks and trust companies.

(h) Boards of Trade.

Two large placards, announcing clean-up week, were posted on the windows in each street car operating in the city. On the back of this placard a silhouette of William Penn attracted the attention of the public, so that upon entering the street car, most persons, having their curiosity aroused, immediately proceeded to read the news on the side of the poster inside the car.

The same placard was distributed to schools, libraries, clubs, lodges, commercial and industrial establishments and railroad companies, with the request that they be posted in a prominent place.

Seven hundred and fifty thousand gummed labels, suitable for attaching to envelopes, packages carried through the mail and delivered by the department stores, were distributed to all public service corporations, department stores, newspapers, banks and trust companies. These gummed labels were very attractive and were found to be a most effective means of advertising.

Two hundred and sixty thousand four-page bulletins were distributed by the police at each home. These bulletins were not simply thrown upon the porch, but were handed to each householder, so that they could not help but learn the message it conveyed. This bulletin was so designed that the back could be used to notify the city waste collectors wherever there was rubbish to be moved. This bulletin contained many suggestions and means by which the citizens might cooperate with the city officials.

Twenty thousand colored display placards were distributed to the department stores and all retail merchants in the city of Philadelphia. These were posted in prominent places in all of the large show windows. Because of the artistic coloring and the simplicity of this placard, it made a very attractive window show card and was very popular. Much larger posters, but similar in design, were posted on all the bill boards in Philadelphia. Many of these same posters were used on hauling wagons and automobile trucks.

Seven hundred and fifty streamers, two feet by three feet, with the words, "Clean-Up Week, April 20 to 25," were given to the industrial and commercial institutions in the city and were used extensively on the harness of the horses of delivery wagons and in some instances tacked on the side of the wagons. Some of these were plain white with black lettering and others yellow with blue lettering.

One million yellow cardboard folders were printed and distributed to all retail dealers, Union headquarters, lodges, clubs, social centers, public service corporations, department stores, etc., with the request that they be sent out in packages delivered and in all envelopes containing monthly statements.

Three hundred thousand badges and

three hundred thousand blotters, containing information regarding clean-up week, were distributed to the public and parochial schools.

Three hundred and fifty thousand circulars were distributed to the policy holders of the Metropolitan Life Insurance Company, requesting their cooperation in Philadelphia's clean-up week. (Thru the cooperation of the insurance company.)

Several colored slides, indicative of the spirit of Clean-up week, and containing information regarding same, were made up and sent to the moving picture theaters, of which there are 205 in the city. It is estimated that 700,000 people attend moving picture performances daily and there is no doubt in our minds that this was one of our most effective means of advertising.

Programs, leaflets, circulars, etc., were used by the theaters and moving picture houses. A number of the commercial interests in the city took advantage of the spirit of clean-up week and advertised their wares and commodities, useful for clean-up week.

Bulletins of various organizations thruout the city, such as the City Club, Civic Club, Business Men's Association, etc., devoted a great deal of space to clean-up week. Many of these organizations prepared letters and circulars of their own which they distributed among their members.

Return postal cards were sent to the owners of all insanitary vacant lots, urging them to both clean and beautify their properties. Over six hundred of these cards were sent out.

In addition, a very extensive newspaper campaign was carried on, which reached its climax in the issues of Sunday, April 19th, immediately prior to clean-up week. Articles by prominent men from all walks of life, commending the clean-up week spirit, were printed in all the morning papers. Leading up to clean-up week, practically every morning articles appeared relative to some new step made by the committee, and in this way the interest of the public was gradually aroused and their cooperation obtained.

Clergymen, in addressing their congregations on Sunday, April 19th, requested the cooperation of their parishoners in the endeavor to make Philadelphia "spick and span."

Many neighborhood contests were instituted and prizes were offered to the boys and girls doing the best work during clean-up week. Garden contests were encouraged and the use of vacant lots for garden purposes was heartily endorsed by the combined committee.

Many addresses and lectures were given by members of the clean-up week committee and city officials, instructing the citizens of the advantage to be gained thru clean-up week.

In all the advertising matter which was displayed, the householders were advised of the fact that the city would remove all the waste accumulated in the grand cleaning up. They were advised that this material would be collected on the days of the regular ash and waste collections. Arrangements were made with all the contractors collecting waste and ashes in Philadelphia, to put on many hundred additional teams to take care of the excess material during this week. Special teams were arranged to remove material where it was accumulated on vacant lots. All of the municipal buildings were given a thoro cleaning and all the offices and desks of the employes were cleaned out. A great number of department stores, public service corporations, etc., also issued orders to their employes along the same line.

The city painted most of the fire plugs during this week and the United Gas Improvement Company repainted their lamp posts. Wherever we could not secure the cooperation of the property owners in cleaning up vacant lots, the division of sanitation of the Bureau of Health issued mandatory orders upon the owners. If these orders were not complied with, the work was done by the city and the properties liened in accordance with the Acts of Assembly.

Arrangements were made for extra dumps in all parts of the city, to temporarily take care of the excess material. The material collected on these temporary dumps was subsequently removed to the city's authorized disposal stations.

Of course, the whole campaign depended upon the cooperation of the citizens, it being their duty to thoroly clean out their own premises and put the waste material at a place readily accessible to the city waste and ash collector for removal.

The response of the citizens to the call issued for their cooperation during clean-up week exceeded all expectations. There seemed to be no particular class distinction between the persons cooperating with the city in its campaign. In every locality, tremendous amounts of waste and rubbish were placed out for collection. All old material which had accumulated thruout the winter in the attics and cellars and about the house, such as old beds, frames, springs, mattresses, broken bottles, glass, chinaware and crockery, broken chairs, tables, benches, bureaus, washstands, rockers, old carpets, rags, decayed wood, tins cans, plaster, great quantities of ashes, straw hats and a great number of Christmas trees which had probably been about the house and yard since the holiday season. In fact, every thing from a tin can to old

and dilapidated grand pianos, were removed by the city waste collectors.

In many sections of the city so much material was accumulated in the houses and put out for collection that sufficient receptacles could not be obtained and material overflowed into the highways. In these cases it was necessary for the city to obtain extra help in shoveling paper and waste into wagons.

Over five hundred lots were cleaned up and placed in a sanitary condition.

The Clean-Up Week movement received such a tremendous impetus that it was impossible to complete the cleaning up dring the week of April 20th to 25th, and, accordingly, the movement was continued during the following week.

I wish particularly to commend the activity of the Philadelphia Boy Scouts in all sections of the city. Many vacant lots and yards and other properties were cleaned up thru their activity. Before the campaign started, schedules were arranged so that their work could be carried out in systematic order. Many of the local business men's associations conducted campaigns of their own in their respective localities. Members entered into the movement with great enthusiasm. In some places they did the actual physical labor themselves. It was not an uncommon sight in any part of the city to see the business men, women, girls and boys working together, the men with their coats off and their sleeves roled up.

It is estimated that during Clean-Up Week over 135,000 cubic yards of waste material were collected. This material, if placed on a city lot three hundred feet by three hundred feet, would fill it to a depth of approximately forty feet, or the top of a three-story building.

Altho Philadelphia's clean-up weeks have not been in existence a sufficient length of time to make a perceptible effect upon the death rate and fire rate of the city, we have all reasons to believe that if these annual institutions continue with the success they have during the past two years, Philadelphia will be the cleanest, most healthful and the safest city in the United States.

R. Robinson Barrett,
Chief Inspector of Nuisances, Division of Sanitation, Bureau of Health, Philadelphia, Pa.

Care of Sewage Disposal Plants

The Editor of Municipal Engineering:

Sir—Municipal sewage disposal plants are often condemned, not always because of their inefficiency, but because, when installed, they have been turned over to inexperienced men, and have not received intelligent care. This is especially true with small municipalities, where the care of a newly constructed sewage disposal plant is often turned over to the street superintendent or village constable.

A properly designed plant requires very little attention, so that after awhile it is taken for granted that it can be left to take care of itself. This is fatal, because while the plant may not need much attention, to operate successfully it must have the little it does need.

Then, again, new connections with the sewers are being made from time to time; a plant is built for a specific daily flow of sewage, and, while it has a considerable margin of safety both ways, it rarely happens that the man in charge is sufficiently familiar with its technicalities to know when it is being overloaded. Complaints are made to the municipal authorities, who probably know even less about the plant than the man in charge, and the plant is condemned.

I know an instance where a septic tank and contact beds were designed and installed for 25,000 gallons of sewage daily. The first year or so, people knowing nothing of its source were actually drinking the effluent. In the meantime, connections were added until in the course of a few years 400,000 gallons of sewage were passing through the plant daily. It had received no attention whatever, complaints were being made, and it is hard to make a great many of the inhabitants of that village believe anything but that the septic tank is a total failure.

On the other hand, if a plant is correctly designed and receives intelligent care, its efficiency is remarkable. At a point where every drop of water used had to be hauled something over 100 miles, I installed a plant in 1906-7 consisting of septic tanks, contact beds and a pair of auxiliary filters. From the filters the effluent passes into a sump, from which it is pumped back to the power plant and used for locomotive and stationary boilers. Aside from being the best boiler water he had ever seen, the superintendent in charge of the plant recently advised me that the care of the entire plant, pumps and all, did not occupy more than twenty minutes of his time each day, and that a saving of $2,000 per month had been effected by using the effluent for boiler purposes, thereby reducing the cost of hauling water, from the time the plant was built until the present time, a period of seven years; in all that time the tanks had never been cleaned out, and the effluent is as good today as ever.

These are extreme cases, but they serve to illustrate the point I am trying to make, i. e., that a perfectly good plant may be condemned for lack of intelligent care.

If a plant is improperly designed, it very soon becomes a nuisance, and no amount of care is going to help matters. Unfortunately, there are hundreds of such plants in existence.

The great trouble has been that many engineers with but little knowledge of the fundamental principles of the septic process have undertaken to design septic tanks. This lack of knowledge, coupled with the natural desire to make a low figure in order to secure business, and the tendency on the part of city and town officials to be influenced by cost rather than efficiency, has led to the designing and installing of plants under the name of septic tanks in which it was impossible for the septic process to be developed to the stage of efficiency.

Another thing which has tended to produce these unfortunate results has been the widespread belief on the part of the engineering profession that the Cameron patent related to the apparatus for developing the septic process instead of the process itself, and in their efforts to evade what they understood to be the Cameron patent, the design of the apparatus, or septic tank, has been so modified that its efficiency is sacrificed. Their failure to fully understand the underlying principles of the septic process prevented their seeing that the modifications they felt it necessary to make in the apparatus, in order to evade the patent, destroyed its usefulness.

The deplorable part of this whole matter is that many municipalities, large and small, have been saddled with systems of sewage disposal which, in some cases at least, have proved to be an absolute menace to the health of the community, while the money invested in them has been largely wasted, because such plants can only be made to perform their proper functions by either replacing them entirely, or by making radical changes in their design at considerable expense.

These results are not at all surprising when the entire situation is understood in all its details, but it serves to emphasize the fact that municipal authorities in a matter of such vital importance to the communities they represent should exercise greater care in the selection of those retained to advise them in such matters, and, profiting by the experiences of the past, make careful inquiry as to the success or failure of plants already installed by engineers who are under consideration with respect to contemplated improvements of this nature.

Moreover, arrangements could very properly be made so that, when a plant is completed, it shall be operated under the general supervision of the designing engineer for a period of years. Such provision would be some measure of assurance to the municipality, while the engineer would probably hesitate to accept this responsibility unless he felt confident that the plant he proposed to install would do all he claimed for it and be no discredit to him professionally. It must not be lost sight of that there are many engineers, who, while entirely qualified to lay out a system of sewers, may not be so well qualified to design a system of sewage disposal, which is really a separate and distinct branch of sanitary engineering.

H. D. Wyllie,
Chicago, Ill.

Buckling of New Brick Pavement at Elmira, N. Y.

The Editor of Municipal Engineering:

Sir—Municipal Engineering for July contained, on page 50, an article by John T. Calkins, relating to the buckling of a new brick pavement on Church street, in the city of Elmira, N. Y.

We have been at some pains to inquire into this matter, as the buckling of any kind of brick pavement is unusual. We ascertain that the pavement was repressed brick. The grouting appears to have been good. The blow-up was due primarily to expansion, of course, but a contributory cause may be found in the break in the grade at the crown intersection of Church street with Foster street, the point at which the blow-up occurred.

The respective grades are plus 1.58 and plus 0.5, a total change of about 1 per cent., according to information given us by the State Highway Department, which supervised the work.

Thurber A. Brown, assistant, and acting, city engineer of Elmira, writes us that the pavement is 36 feet wide between curbs and 66 feet wide at the intersection. The buckling occurred about half way between the ends of the pavement.

No break occurred except at this point, altho a heave of about 1 inch occurred in the gutter 35 feet west of the break.

The gutter is continuous crossing the intersection, and at the intersection expansion joints are against the headers of the intersecting streets. The cross-street (Foster) is a dirt street, and the pavement is laid only to the street lines of Church street, with a crown of ¼-inch to the foot.

The break occurred on the section bounded by the curb lines of Church street, and transversely of the street, the extremes of the break being defined by the extension of the intersection, upon which the brick were laid longitudinally—that is to say, at right angles with the brick in the pavement proper.

The slab upheaved on the east grade (the 1.58 per cent.) was 2.60 feet wide, and the slab upheaved on the west grade (the 0.5 per cent) was 1.60 feet wide at the end of the break where the slabs did not break up.

At the other end of the break, where a crushing effect was produced and the slabs were somewhat broken up into integral bricks, the push seemed to be from the east side, as heavy sections of the west side slab were thrust back upon the pavement the width of two bricks, as shown in the photograph taken immediately after the blow-up.

The circumstance that the pavement had no cross expansion joints has been seized upon by advocates of that system as proof of the validity of their contentions, and the city council has forced the State Highway Department to use cross joints in new work. Practical paving men know by experience that transverse joints are a positive detriment to brick pavements, but it is so difficult to root from some minds an idea inherited from an era of error that it is hardly worth while to adduce arguments or cite facts in disproof of the theory that cross expansion joints are more useful than harmful.

Street intersections usually are the weakest places in a brick pavement, especially if the lateral thrust of expansion is against an elevated paved crossing. The weakness is increased if a break in grade occurs at a crown intersection, as in that case there is unequal distribution of resistance to the thrust of expansion.

Whatever may have been the efficient cause of the blow-up at Elmira, the case is unusual. It does not constitute a true bill of indictment against the efficiency of longitudinal joints. Extending easterly from Conneaut, Ohio, to the Pennsylvania state line, on the main highway which runs from New York to Chicago, is a grouted brick pavement which was laid six years ago and still is in perfect condition, altho the traffic over this road is perhaps as great as over any other highway in the United States. The only repairs ever put on the pavement were on a short section where, at the line of the only cross-expansion joint in the entire pavement, a bad blow-up occurred three years ago. Let one blow-up offset the other; but it is hardly reasonable to generalize from either particular instance.

The erroneous assumption that whereas longitudinal expansion joints cause blow-ups, transverse joints avert the same, is disproved by the fact that altho during the past four years 2,750,000 square yards of wire-cut-lug brick have been laid with cement grout filler and, with the exception of a very small percentage, with no cross joints, not a single instance of a blow-up or buckling of any kind, has been reported against that type of brick. If a blow-up ever does occur with this brick, it will be where a transverse joint has been put in despite our vigorous protest, or on account of defective grouting.

Generally speaking, engineers believe that buckling usually results from the yielding of a weak bond under stress of expansion due to thermal influences. The fact that there is no recorded instance of a wire-cut-lug brick pavement having buckled, proves conclusively that a strong bond, aided by a longitudinal expansion joint, is able to withstand the ultimate force exerted by the expansion of a pavement.

If the Elmira incident was due to failure of bond, doubtless it was because the smooth surface of the repressed brick did not afford the bonding material strong grip, so that the filler broke away from the brick. This supposition is purely theoretical, of course, as the upheaved brick had been removed from the street before our representative visited Elmira; but the theory is tenable, in view of the tendency of grout to cleave away from a smooth-surface brick under strain.

The fact that a wire-cut-lug brick pavement has never been known to buckle is attributed to the uniform lugs and beveled ends of the brick, which allow free flow of the bonding material, and the rough contact surface of the brick, which assures a structural union between grout and brick.

Our object in writing you at so great length is to show the singularity of the Elmira blow-up and to assure you that wire-cut-lug brick was not involved in the matter, nor is it likely to be involved in any such catastrophe in future if it is properly put down.

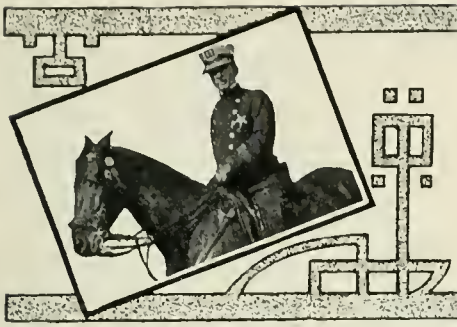
THE DUNN WIRE-CUT-LUG BRICK CO.

A Tin Smelter Needed

The high price of tin since the war began is not due to cutting off production of tin ores in the countries engaged, but to the difficulties of transportation and the location of tin smelters only in those countries.

A tin smelter in this country, say the revival of the one formerly in Bayonne, N. J., and American lines of transportation to South American and other deposits of tin ore, would relieve the situation. The Bayonne plant was ruined by the heavy export duty put on Malayan tin ores by the British government. Transportation for ores closer home is what is now needed.

Tin prices have been fixed in London heretofore. Independence of the London markets can be achieved if American manufactures and American transportation lines will step into the breach promptly.



LEGAL DECISIONS

Decisions of the Higher Courts of Interest to Municipalities

City Must Pay for Trees Removed—Where a municipality, in changing the grade of a sidewalk of the street upon which plaintiff's property abutted, unnecessarily removed shade trees, the removal being without legal justification, the municipality is liable for all damages suffered. Worth v. Town of Westfield, (N. J.) 90-Atl., 727.

Selection of Patented Material for Pavement is Legal.—Under Rev. St. 1909, Sec. 9619, relating to cities of less than 30,000 inhabitants incorporated under a special charter, contracts for street improvements are required to be let to the lowest and best bidder; but it is not a violation of such provision that there is a patented article or one held in monopoly which in the eye of the authorities is of such exceptional value that it would be a public injury to be deprived of it. Where a city council is by law invested with authority to prescribe the character of a proposed street improvement, its action in good faith in selecting a patented material controlled by a monopoly cannot be impugned on the ground that such material in fact possesses no points of superiority over others used for the same purpose. Evidence that patented concrete selected by a city council for a street improvement was not superior to the ordinary concrete, which was less expensive, did not show bad faith on the part of the city council, since there is much difference of opinion regarding the kind and character of material for paving streets and much discretion must be left to the council. It was not improper for a city council to give consideration to the request of a majority of the property owners that a particular kind of concrete be used in the street improvement, where such material was not selected arbitrarily in obedience to such request, but only after the councilmen had convinced themselves that such concrete was a meritorious article. Meek et ux. v. City of Chillicothe (Mo.) 167 S. W., 1139.

Village Liable for Hydrant Rental Beyond Contract Period if Used.—A village authorized by Village Law (Consol. Laws, c. 64) Sec. 220, to contract for the supplying of water to it for the extinguishment of fires, etc., was liable on an implied contract for hydrant rental at the date previously paid, where, after a demand of the water company for a higher rate had been rejected by the taxpayers, the hydrants were used by the local incorporated fire company. Marlboro Water Works Co. v. Village of Marlboro (N. Y.) 148 N. Y. Supp., 374.

Town Cannot Transgress Law Fixing Limit of Funds for Water Rental.—In a suit to recover rents of $900 a year for a water supply for a town, under a contract for the purchase or leasing of such water supply, where such sum exceeds the amount to be raised by taxation from a two-mill levy upon the taxable property subject to taxation in said town, no recovery can be had for any amount in excess of the amount raised from such two-mill levy, under subsection 72 of section 2402, Compiled Laws of New Mexico 1897. A town or municipality, when sued upon a contract which it was not authorized by law to make, or has not complied with the statutory requirements in the making of the contract, is not estopped to deny the validity or want of power in making such contract, or prohibition by statute to secure the funds with which to discharge its obligations under the contract, and prevent a recovery upon a quantum meruit upon the contract. Hageman et al. v. Town of Hageman (N. M.) 141 Pac., 613.

Lease of Water Works Invalid if Really Unauthorized Purchase Contract.—An ordinance or contract of the town of Hagerman, termed a "lease," entered into for the purpose of securing a water supply for said town, whereby the town was to become the owner at the expiration of ten years, upon the payment of $900 per year as rental for such period, construed and held to be a contract of sale, and, as such, a purchase by the town of waterworks under subsection 6 of section 2402 Compiled Laws of New Mexico 1897, and such contract held to be invalid and un-

enforceable against the town in a suit to collect the rents by reason of such contract not having been approved by vote of the residents of the town at a general election. Hagerman et al. v. Town of Hagerman (N. M.) 141 Pac. 613.

Methods of Dedication of Streets.—Condemnation, dedication by deed or under the statute, and prescription, are not the only methods of creating a street, for a street may be created by common-law dedication, which arises out of acts by the owner showing on his part an intention to dedicate. No particular formality is necessary to a common-law dedication of land for a street, thus the mere throwing open of land to public use as a street, coupled with the fact that others purchase in reliance on the existence of the street, is sufficient. Time is not an indispensable element of a common-law dedication as in the case of prescription, and a dedication when accepted and acted upon is irrevocable, tho the property dedicated has not been used as a street for the prescriptive period. Drimmel v. Kansas City (Mo.), 168 S. W., 280.

Liability of City for Defective Sidewalk.—Until accepted, a municipality is not responsible for the condition of a street attempted to be dedicated. The acceptance of a street dedicated to public use need not be express, but may be implied from the acts of a municipality in doing work thereon or recognizing it as a public street. Where a city accepts the dedication of a street, and it is graded and a sidewalk placed thereon, that is an invitation to the public to use it, and the city is bound, regardless of who placed the sidewalk there, to maintain it in a reasonably safe condition for travel. Drimmel v. Kansas City (Mo.), 168 S. W., 280.

Authority for Changes in Contract for Bridge.—Laws 1903, c. 444, providing for the construction of a viaduct in the city of Milwaukee, required the county to prepare complete plans and specifications, to advertise for bids and let the contract to the lowest bidder, and to enter upon the construction of the viaduct, bridge, and approaches in conformity to such plans and specifications. *Held*, that such provision did not preclude the county from making any changes in the plans and specifications after the contract had been let, but that the county was authorized, as necessity required, to make proper changes. Section 668 declares that county board, by resolution, may authorize its chairman to appoint committees to perform the duties and report as prescribed in the resolution. *Held* that such committee had power to make changes in the plans and specifications, provided they did not substantially alter the character of the structure or unreasonably increase its cost. *Held*, that, since the county in the first instance might have contracted that the required notice need not be in writing, it had power to waive such provision, and the engineer having made changes and ordered additions, with the approval of the county board or its committee in charge of the work, and having refused to make such orders in writing, the requirement was waived. Where a county board, engaged in the construction of a concrete viaduct of great proportions, delegated its powers in connection therewith to a committee of its members, and many of their meetings were necessarily of an informal character consisting of consultations with the engineer in charge of the work, at which all the members might not be able to be present, the rule that, where a statute requires a thing to be done at a meeting of the county board, the act cannot be done by separate individual action of the members of the board, but must be done at a duly called meeting, was inapplicable, and hence the fact that a change in the method of construction of arches was ordered at a meeting of the committee, at which all were not present or notified, did not render such action invalid. First Savings & Trust Co. v. Milwaukee Co. (Wis.), 148 N. W., 22.

Exclusive Contract to Collect Garbage Legal.—Under Rochester City Charter, Secs. 85, 235 (Laws 1907, c. 755), providing that the city shall have authority to preserve the health, safety, and welfare of its inhabitants, and that the board of contract may let contracts for the collection, removal, and disposal of ashes, garbage, and dead animals and for cleaning and sweeping the streets, the city could pass an ordinance prohibiting the collection of garbage by persons unlicensed by the bureau of health and then declaring that no licenses should be granted except to the person or persons having a contract with the city for the collection of garbage; such ordinance being a reasonable exercise of the city's police power, regardless of the fact that it might incidentally affect the rights of private persons to collect and use garbage. The validity of a statute or ordinance is not to be determined from its effect in a particular case, but from its general purpose and its efficiency to accomplish the end desired, and when a statute is obviously intended to provide for the safety of the community, and an ordinance under it is reasonable and in compliance with such purpose, both statute and ordinance are lawful and must be sustained. City of Rochester (N. Y.) v. Gutberlett, 105 N. E., 548. See also a Detroit case, Gardner v. Michigan, 199 U. S. 325; and a San Francisco case, California Reduction Co. v. Sanitary Reduction Works, 199 U. S., 306.

ROADS AND PAVEMENTS

Relation of Traffic and Cost of Maintenance of Roads

The annual report of the Massachusetts State Highway Commission discusses the relations of traffic, kind of wearing surface and cost of maintenance of roads in the following pertinent paragraphs and tables:

Many engineers in both France and England have for years past been keeping an accurate account of the actual cost of maintaining certain roads, and of the traffic which actually went over the road. Many of these accounts and experiences are extremely interesting and instructive.

A knowledge of the traffic which each particular road will have to carry is absolutely necessary if the best materials and methods of construction are to be used. The same is equally true concerning the methods and materials which should be used to maintain the road after it is built. The most economical surface to use with certain heavy traffic, including interest on cost and maintenance, may be 6-inch granite blocks on a concrete base, while for very light traffic a gravel road, always properly shaped and maintained, may be entirely adequate.

Before deciding upon any particular surface of pavement for any special road or street, if we are to decide correctly, it is absolutely necessary that we should know exactly what traffic, and particularly the kind of traffic, the road must carry, and not only the present traffic but the future traffic as well.

We found in Massachusetts that in three years, from 1909 to 1912, the traffic on our state highways had often doubled. Its character also had changed. Some roads had more heavy teaming—most of them had less, but motor trucks had replaced the teams, carrying actually more tons per day. Automobile traffic had more than doubled, and what were formerly little country roads, with but twenty to fifty teams a day, had now become interurban and interstate thorofares, carrying from 300 to 700 automobiles a day in the season.

What we need is some uniform method of taking traffic counts, and some uniform formula that will fairly represent the weight or damage done by the different kinds of traffic, based upon the weight per yard width per year, or per day, so that we can compare results. After a series of years we should then be able to determine more accurately the surface or pavement which would best meet all the necessary requirements.

Traffic statistics have been made for many years in certain places in England and on the continent. The English Road Board has adopted an assumed weight for various vehicles, and many traffic statistics based upon this formula have been made, and are now available in various reports. We could well adopt the same formula, based upon American tons, so that we could compare our results with theirs upon a uniform basis.

TABLE I—ENGLISH TRAFFIC FORMULA WEIGHTS.

	Assumed weight of vehicles. (Tons)
Motor Vehicles—	
Runabouts	1.43
Touring cars	2.23
Trucks	6.25
Horse-drawn Vehicles—	
Light vehicles (one-horse)	.36
Heavy vehicles (one-horse)	1.12
Light vehicles (two or more horses)	.54
Heavy vehicles (two or more horses)	2.46

The number and class of vehicles having been determined, the traffic per yard width of roadway can be calculated.

Mr. Brodie, city engineer for the city of Liverpool, has made some very accurate studies extending over a period of ten years, covering the weight of traffic per yard width per year, the life of the road, life tonnage per yard width, cost per yard, per ton, etc. His table, which is given herewith, can be studied with great advantage.

TABLE II—GIVING PARTICULARS OF EXPERIENCE OBTAINED IN LIVERPOOL WITH DIFFERENT CLASSES OF SURFACE PAVEMENT.

Pavement.	*Tons per yd. width per annum.	Life, years	Life, tonnage per yd. width.	Cost per sq. yd. of surface.	Annual cost, including prop'n of capital and maintenance per sq. yd.	Ton miles per yd. width per penny.	Cost per traffic per mile.
6-in. setts	524,000	18	9,432,000	$2.50	$0.170	34.0	$0.058
4-in. setts	150,000	50 (Est.)	7,500,000	1.87	.070	24.0	.080
Hard wood	162,000	17	2,754,000	3.37	.250	7.4	.272
Soft wood	204,000	18	3,672,000	2.12	.115	15.5	.128
4-in. pitch macadam	120,000	11	1,320,000	.75	.066	20.6	.096
7-in. water bound macadam	120,000	1	120,000	.02	.180	7.6	.264
7-in. water bound macadam, tar sprayed	120,000	2	240,000	.25	.112	11.4	.180

Note.—Tonnages on Road Board basis, except that which, being exceptionally heavy traffic, is based on estimated total actual weights.

*English ton—2,240 pounds.

You will note that the average cost of maintenance, including capital charges, varies from 7 cents for certain granite sets to 25 cents per square yard per year for certain wood blocks (7 cents for pitch macadam and 4-inch granite sets).

The pitch macadam was practically a trap-rock macadam where large stones were used, grouted with a mixture of hot sand and pitch, equal volume, till it flushed, and then smaller stones were rolled in, a surface coat and grits applied on top, and rolled in. One such road is now eleven years old, has not yet been repaired, and has carried a traffic of 120,000 tons per yard width per year.

On the average state highway in Massachusetts, with 15 feet in width of macadam, this would mean 600 to 700 vehicles a day; not, of course, on a real heavy teaming street, but average traffic.

These figures do not really, however, tell the story of the actual cost, but the cost per ton mile shows better what duty the road has performed.

The wood block carried less than 7½ tons per yard width for each penny expended, the pitch macadam carried over 20 tons, and 6-inch granite sets on a concrete base carried 34 tons. Water-bound macadam carried only 7 6/10 tons, but if it was tar sprayed, it carried nearly 11½ tons, for each penny expended.

Another way of stating the same result is the expenditure for maintenance for each ton transported 1 mile. This cost varied from under .06 of a cent per ton on 6-inch granite sets to about .27 of a cent for hardwood block and water-bonnd macadam; while tar-sprayed macadam cost .18 of a cent, or only two-thirds as much as water-bound macadam; and pitch macadam cost over .09 of a cent, or about half the cost of the tar-painted macadam.

Any engineer will find himself amply repaid if he makes a careful study of the traffic statistics and costs which are set forth in many of the papers, both French and English, presented at the International Road Congress, and in the reports of the English Road Board.

Note, also, that the kind of traffic which has to be carried, makes the most difference of all. Every road surface must be strong enough not to be crushed, or broken through, by any vehicle that goes over it.

On the Liverpool paved streets, near the docks, 30 tons on four wheels is not an unusual load. Traction engines on iron tires, weighing 12 tons with their load, are common, as are also two or three trailers, weighing, with load, 8 tons each.

Both surface and foundation must be strong enough to bear up every vehicle, without any appreciable rutting or breaking, or the road will be rapidly destroyed.

The cost on different roads in England is given in a table published in connection with the International Road Congress, pamphlet No. 88, report by Messrs. H. T. Wakelam, A. Dryland, Col. R. E. Crompton, C. B., and T. W. A. Hayward.

This table of costs is for water-bound macadam roads, and a very few tar-sprayed roads.

You will note that there are tremendous variations in cost. The maintenance cost on some of these roads is as low as 14/100 of a cent per ton mile, and on others as high as 1 2/5 cents. Evidently, much further study is necessary to show not only the reason but the remedy for some excessively high costs.

TABLE III—SHOWING WEIGHT OF TRAFFIC IN TONS CARRIED ONE MILE FOR ONE PENNY OF MAINTENANCE COST.

County. Place.	Weight of Traffic in Tons.	Per day.	Per annum.	Average cost per mile per annum.	Weight in tons carried 1 mile for 1 penny	Cost of maintenance in pence per traffic ton mile. (penny). (cents).
Norfolk—Weybourne	39	14,200	41 5	1.4	.71	1.42
Norfolk—Edgefield	96	35,000	16 "	9.0	.11	.22
Warwick—Gaydon Cross Rd.	185	67,500	86 "	3.2	.31	.62
Warwick—Wooton Waven..	239	87,200	127 "	2.9	.34	.68
Warwick—The Asps.....	242	88,300	86 "	4.3	.230	.46
Kent—*Near Charing.....	348	126,700	299 "	1.7	.590	1.18
Norfolk—Framlingham	359	131,000	73 5	7.4	.130	.26
Norfolk—Lyn-Ely	385	140,500	56 5	10.4	.096	.192
Norfolk—Diss	390	142,300	55 "	10.7	.093	.186
Warwick—Haselor Bar.....	451	164,600	127 "	5.4	.18	.36
Norfolk—E. Carleton.....	504	184,000	50 5	15.1	.066	.132
Kent—Road No. 20.....	528	192,100	348 "	2.2	.45	.90
Warwick—Willenhall	609	222,000	269 "	3.4	.29	.58
Warwick—Elmdon	734	268,000	419 "	2.7	.37	.74
Warwick—Styvechale	736	268,600	134 "	7.9	.127	.254
Kent—*Road No. 91.....	796	289,800	192 "	6.3	.16	.32
E. Sussex—Roedean	984	359,000	333 "	4.4	.22	.44
Norfolk—Diss 1,057		386,000	218 "	7.3	.13	.26
Kent—Sidcup 3,030		1,102,810	2,100 "	2.1	.47	.94
Kent—*Sidcup 3,030		1,102,810	1,792 "	2.5	.40	.80
Surrey—Putney 5,694		2,078,300	1,032 "	8.4	.12	.24
Surrey—*Putney 5,694		2,078,300	604 "	14.3	.08	.14
Average of Norfolk Roads..9,023		3,300,000	2,298 "	6.0	.16	.32
Av. of Warwickshire Roads.9,777		3,569,000	3,965 "	3.7	.27	.54

*Note—Surface tarred.

COMPARISON WITH TWO MASSACHUSETTS ROADS.

*Beverly 2,898		1,058,430	$3,257	6.50	.185	.37
*Weston 1,920		699,924	1,993	7.02	.14	.28

*Period of 14 years.

I have shown two of our state highways merely for the purpose of comparison, and you will note that the cost of water-bound macadam roads is about the average. Where it costs more it becomes evident from looking over the Liverpool statistics that the pavement is entirely inadequate to carry the loads which are going over it.

These statistics, varying as they do, show the absolute necessity for accurate traffic data as a prerequisite to the selection of a road surface or pavement.

In some of the reports of the French engineers, many costs are given which are of much value for traffic in this country. For instance, the Avenue du Bois de Boulogne in Paris was maintained as water-bound macadam until 1906. It had to be renewed every three years. The annual cost for maintenance was about 39 cents per square yard per year. In September, 1906, it was tarred, and the annual cost of maintenance has fallen to about 25 cents per yard per year, or about two-thirds. It must be remembered that this is a very wide avenue with a tremendous traffic in automobiles and pleasure vehicles, but with little or no teaming.

Asphalts and asphaltic residuums have been but little used in England or France, probably because the tar products are much cheaper, so that it remains for us in this country to keep accurate data, and costs figured on a uniform basis, to determine in each locality what is the best and most economical material that can be used on that particular road, to carry adequately the traffic which will pass over it.

An Unsupported Brick Highway in Continuous Use.

By Herschel H. Macdonald.

For sixteen months a rural brick pavement, 70 square yards in extent, has hung over the void near Tinker's creek, Cuyahoga county, Ohio. Now the county commissioners are preparing to put a roadway and a base under their pavement.

There is no apparent reason for their step, except the caution which is always counted an official virtue. The pavement has projected like a roomy shelf over the void, 80 feet long and 6½ feet in width, ever since March, 1913. For some time

WASHOUT *of Dunham Road brick pavement by Tinkers Creek, near Cleveland, O. Note brick surface intact and that much of the concrete foundation has dropped out. Sections of concrete wall are lying in and along the water of the creek across the foreground of the picture, with a standing section at the left partly undermined.*

the pavement was used without a guard rail. Later a guard rail was erected to keep vehicles from venturing over the edge of the shelf.

It will be remembered that floods visited Ohio in March, 1913. Dayton was the heaviest sufferer. Northern Ohio, owing to the depth of its river valleys, escaped with little damage. Part of the damage, however, occurred where Tinker's creek runs parallel to Dunham road. At this point a retaining wall of heavy stone blocks had been erected and the road built up to a height of some 12 feet above the bed of the creek. Upon the fill a modern brick pavement with a concrete base had been constructed.

The flood completely submerged the road for several days and when it receded, it was found that the wall had been undermined and scattered for a distance of several hundred feet down stream. Nearly half of the roadway had been excavated by the force of the water and the concrete base, deprived of its support, dropped to the bed of the creek.

All that remained was the actual pavement, an unbroken surface of well-grouted brick. The first impulse of the road authorities was to break down the brick shell, to prevent its use, and to rebuild the entire road from the bottom. A man with a sledge was set to work to demolish it. When he had labored for ten minutes and had only broken a single brick, the man in charge decided that such a pavement could not be much of a menace to traffic and so allowed it to stand.

The fame of the phenomenon spread and people came by the score to behold a highway supported by the ether. Innumerable automobiles ventured to the edge of the overhang, until caution dictated a fence along its edge to prevent vehicles from plunging into the creek. A portion of the width of the overhang, however, has always been subjected to traffic since the washout.

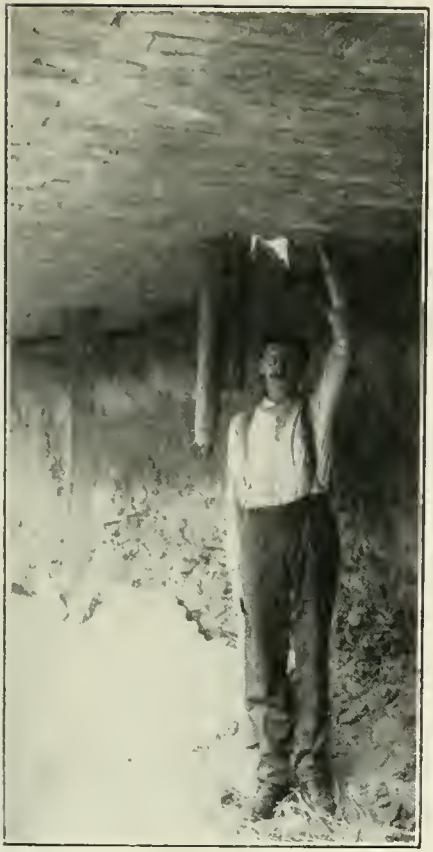
The incident has proved a most effective lesson in a cardinal principle of good paving practice, a principle which has made Cuyahoga county roads conspicuous thruout the country. That is the proper use of a grout filler composed of one part Portland cement and one part of fine, sharp sand.

This lesson was not learned in a day, either in Cuyahoga county or elsewhere. Its experimental era was marked by many roads of merit. The early builders were fortunate in being allowed to correct their own mistakes, as well as in the fact that they prepared a type of road that would withstand auto traffic long before that traffic could have been foreseen.

The Dunham road pavement presents no unusual features, excepting the strange test to which it was subjected, which, impressive as it is, was not made under conditions, the identical of which might be found in any properly constructed brick highway.

Arch action can have played no part in maintaining the pavement's position. The longitudinal grade of the unsupported portion is an almost perfect level. There is a slight lateral crown comparable to a half-arch, but it is the crown rather than the base of the arch which is supported. The base has no support excepting the lateral bond.

Lest authorities seem to have been remiss in allowing repairs to be so long delayed, it is only fair to say that the principal delay was caused by a project to divert the road, which would have involved the condemnation of land and other lengthy controversy. The delay, however, has been an advantage from the standpoint of the test, as time and the frost action of a severe winter have made the demonstration daily more impressive and opportunity has been afforded for a large number of paving experts to visit



WASHOUT *of Dunham Road brick pavement near Cleveland, O. This photograph shows the underside of the brick pavement and the extend of its overhang. 6¾ feet. The posts seen were set to hold a railing to keep traffic from the edge and do not support the pavement in any way. Traffic passes regularly over the brick pavement between these posts and the earth on the right, which supports the other half of the pavement.*

the scene and glean such practical lessons as might be had from close inspection.

More than 150 engineers and road authorities, from all parts of America, went to Tinker's creek in a body to satisfy themselves with regard to a situation which had been heralded to most of them thru the technical journals.

At first they approached it with caution, but curiosity and admiration overcame them and they were soon distributed over and under the shelf without apparent fear of collapse, so much were they impressed by the evident rigidity. No feature of the conference made so deep an impression nor excited so much comment, and the program included visits to more than fifty miles of pavement in various stages of construction and age.

Cleveland and Cuyahoga county now boast more than 1,100 miles of brick paved city streets and country roads, forming what engineers declare to be the most remarkable system of permanent paving to be found in the world.

Asphalt Paving Repairs in St. Paul, Minn.

In the budget of St. Paul, Minn., for 1912, $15,000 was appropriated in the general fund for the purchase of equipment for making street paving repairs. In February bids were called for for a portable asphalt plant, and later other equipment was purchased under competitive bids. The entire plant installed under this appropriation and in use in 1912 consists of a Warren Brothers portable asphalt plant, one 8-ton asphalt steam roller, one scarifier, one Lutz surface heater, one fire wagon, one gyratory stone crusher, two portable melting kettles, six 2-yard steel-lined asphalt wagons, four ¾-yard concrete spreaders, one set of curb-cutter's tools, nine asphalt rakes, testing scales and the necessary small tools.

The plant was put in operation on April 25, and during the season of 1912 was worked a total of ninety-two days; 19,428 square yards of asphalt pavement were turned out, 15,040 square yards of this being cut-out work and 4,388 square yards burner work; 5,458.63 square yards of asphalt were put in for paving contractors in repairing asphalt pavements under guarantee; of this, 2,363 square yards was cut-out work and 3,095 square yards burner work. The total cost was $6,012.96, which was billed aganist the contractors and collected in 1912.

All asphalt paving repairs for the year 1913 were made by the municipal asphalt plant. The plant was put in operation March 30, and during the season worked 178 days; 44,193.71 square yards of asphalt paving were turned out, 43,296.36 square yards of this being cut-out work and 897.35 square yards burner work; 16,832.42 square yards of asphalt were put in for the Barber Asphalt Paving Company on streets still under guarantee; of this, 16,039.51 square yards was cut-out work and 792.91 square yards was burner work. The total cost was $21,613.34, which was billed against the company and collected.

7,370.13 square yards of asphalt were put in for the City Railway Company and billed against it, the cost being $11,031.76. 1,249.78 square yards of asphalt

and 147.79 square yards of concrete foundation were put in for public service corporations. This work cost $2,340.65; was billed and collected.

245.99 square yards of asphalt were put in on bridges on which the city maintains the wearing surface; this cost $430.49, and was charged against the bridge building and repair fund at $1.75 per square yard. 8.20 square yards of asphalt were put in openings in street made by city sprinkling department; this cost $14.35, and was charged against the city sprinkling department at $1.75 per square yard.

The repairs to asphalt pavements out of guarantee and paid for out of the street and sewer fund amounted to 18,487.19 square yards of cut-out work. The repair work cost the city $18 490.85, or an average of $1.00 per square yard.

ASPHALT PAVING REPAIRS, 1913.

City repairs made by municipal plant	$18,490.85
City railway repairs made by municipal plant	11,031.76
City bridge repairs made by municipal plant	430.49
City sprinkling department repairs by municipal plant	14.35
	$29,967.45

The distribution of the expense is as follows:

Street and sewer fund	$18,490.85
Bridge building and repair fund	430.49
City sprinkling department fund	14.35
City Railway Company	11,031.76
	$29,967.45

The following shows cost and relative data regarding asphalt repairs for the year 1913:

Total area of pavements on which repairs were made, in square yards	222,327
Area of repairs in square yards	18,733.18
Per cent. of area repaired	8.42
Cost of repairs	$18,921.34
Average cost per square yard of total area	0.085

Cuts in the asphalt pavement made by the water department, heating, lighting and telephone companies, sewer contractors and others, which were repaired, cost $2,340.65, which was collected from the various companies.

The operating crew at the plant consisted of one foreman, one engineer, one tank man, four laborers and a night watchman. Four teams were employed hauling asphalt from the plant to the work.

The street crew was made up of one foreman, one timekeeper, one roller man, two rakers, two tampers, one smoother and one cement man, laying the new pavement, and two shovelers, six scrapers and two teams removing and hauling the old paving. The total expense was divided as follows:

SUMMARY.

Operation of plant, labor	$ 5,889.02
Fuel	1,024.47
Hauling material	1,559.18
Superintendence, livery, watchman, etc.	3,164.21
Repairs and supplies	1,658.05
Material	26,876.59
Street crew labor	8,206.66
Hauling material to street	5,068.40
Engineer and watchman	1,391.65
Tools, repairs, etc	790.05
Total	$55,628.28
Total labor	$25,175.66
Total material	30,452.62
	$55,628.28
Charged to outside parties	$34,194.23
Charged to bridges	430.49
Material on hand	2,512.71
	37,137.43
Total cost of city work	$18 490.85

European Rock Asphalts

Lecture by J. W. Howard at Columbia University.

IT is an honor to respond to the request of Columbia University and present a brief professional paper on the subject of "European Rock Asphalts," which were used for the first successful monolithic or sheet asphalt pavements and other purposes, and are still used extensively thruout Europe and elsewhere. Subsequent to the success of the European rock asphalt or bituminous-limestone pavements, many substitutes, made of artificial compounds, have been used. Success has followed the use of certain compounds of graded sand or graded crushed stone, limestone, or equivalent powdered mineral in small quantities filling voids, and the whole mineral aggregate bound together with asphalt cement. This second general method of constructing asphalt and bituminous pavements was developed in America and predominates here. I will confine your attention to a sub-group composed of natural bituminous limestone, which is one of the general group of rock asphalts, which group also contains natural bituminous sandstone, of relatively little value.

1. *Definition.*—It is best to clearly define the sub-group of bituminous or asphaltic materials to which I call your attention. The deposits of rock asphalt of Europe are natural, bituminous lime-

stone which have been used for more than two hundred years; at first for various coatings and extracting bitumen, and then, beginning about one hundred years ago, for pavements and other purposes. This mineral is composed of fine-grained limestone, thoroly impregnated and saturated with an adhesive, durable bitumen. The bituminous limestone deposits or quarries of Europe, and the few known ones in America and other countries, vary in purity and quality, some of the deposits containing some qualities of sand, clay, etc., in some parts, if not thruout each deposit. The proportion of bitumen or asphaltum present in the rock varies in all deposits from portions not saturated at all, to portions carrying the desired per cent. of this cementing substance and upwards to a large excess of bitumen in the rock, which makes it impossible to use such rock asphalt unless it is thoroly blended with other similar, suitable rock asphalt containing very little asphaltum or bitumen, so that a uniform result contains the per cent. of bitumen required.

2. *History.*—A rapid glance at the names of ancient authors mentioning asphalt, from the Greek word, "asphaltos," and "bitumen," which is a Latin word itself, and known by other words by Hebrew, Babylonian, and other writers, is interesting. The knowledge or uses of asphalt or bitumen, and some compounds, is not new. The following ancient writers, with approximate dates, can be consulted in any large library. The earliest mention I have found is on "Tablet No. 11 of Gilgamesh Epic," antedating four thousand years before Christ, or six thousand years ago, where Utnapshtim states that he "smeared or coated the inside (of a boat) with six measures of Ku-up-ri (bitumen) and the outside with three measures." The Hebrew writers in the Old Testament mention coating the ark, also the basket of Moses, etc., with asphalt, which was long before the present era began. Next followed Greek and Roman writers; Homer about 1000 B. C., Herodotus 430 B. C., Hippocrates 410 B. C., Aristotle 355 B. C., Diodorus 50 B. C., Virgil 10 B. C., Ovid 5 A. D., Pliny 70 A D,. in his "Natural History II.," 106-108. An unknown author, about 1325, mentions it. Mandeville and Trevisa, in the fourteenth century; Copgrave about 1640; Whitehorn, sixteenth century; Shakespeare, 1600; Milton, 1650; Blount, 1656. It was not till 1712 that Doctor D'Eyrinys discovered, and in 1721 published, a description of the rock asphalt at Val-de-Travers, Neufchatel County, Switzerland, and several uses for this material. This was the small beginning of the asphalt industry, which has now spread, in various forms and by various methods of using natural or combined materials, thruout the world, employing many millions of capital in competing groups, large and small, and employing many thousand men. D'Eyrinys, in 1735, opened the bituminous limestone deposits at Lobsann (Germany), which deposit has been worked ever since. About 1797, the deposit at Seyssel, France, was opened, and then, like the others, was used for making asphalt-mastic by extracting the bitumen from some of the rock and enriching the powdered fresh rock with it. In 1802, Count de Sassenay took charge and reformed the methods, very much improving them, getting his supplies from the Swiss and French deposits mentioned. Rock asphaltic-mastic was soon used for floors, sidewalks, public squares, bridges, and then streets. It was in Lyons, France, about 1834, that in mastic form, it succeeded fairly well for street paving. In the same year it entered Paris and rapidly became the almost universally-used, excellent sidewalks of that city, where now more than eighteen hundred miles of it are kept in constant good order. Engineer Meriam began about that time to observe that lumps of the broken and powdered bituminous limestone, dropping from wagons near the quarries, were crushed and coalesced under wheel traffic into a firm, continuous sheet on the roads. It was then that the noted engineer, Leon Malo, of France, entered this industry and devoted his life to it until his death, a short time ago. He is known thruout the world as the father of the asphalt industry. Mr. Delano, of England, collaborated with Mr. Malo in France, and introduced sheet asphalt pavements, made of European rock asphalt, and asphaltic-mastic sidewalks, floors, etc., into England and the cities of almost all nations. He still takes interest in the rock-asphalt branches of the asphalt industry.

It was in 1854 that Mr. Malo, after some experiments, laid the first successful sheet-asphalt pavement. It was made with compressed natural rock asphalt. He demonstrated the necessity of a firm concrete foundation. The wearing-surface layer was made by crushing, powdering, and then heating the bituminous limestone and spreading and compressing it in place on the street. This first street was Rue Bergere, Paris, which, from the first, was successful, and by proper maintenance it has been kept thus paved in constant good order for sixty years to date. At this point it is wise to insert a brief list of authors and authorities on bituminous limestone and its uses. Busch, about 1802, d'Aoust (1834) Purvis (1836), Itier (1839), Millet (1840), Huguenet (1847), Daubree (1850), Hessell & Kopp (1855), Benoit (1860), Homberg (1865), Leon Malo (1866), and his subsequent publications, Delano (1871 to 1893), Jeep (1867), Meyn (1872), Coignet (1875),

Kayser (1879), Woas (1880), Zetter (1880), Ducker (1881), Wein (1881), Dietrich (1882), Schubarth (1883), Narcy (1889), Baumeister (1890), Lonholdt (1891), Jaccard (1895), Haft (1897), Loewe (1906), Boorman (1908), Danby (1913), all of which give more or less details regarding sources of supply and methods of use of the rock asphalts of the kind we are considering.

The success of compressed rock-asphalt pavement in Paris in 1854 and ever since has attracted the attention of all important cities. London, England, began its use by paving Threadneedle street, in 1869, and has steadily extended its use to many other streets of that city. Geneva and Berlin began in 1871, and all the principal cities of Europe soon followed. It began to be used in America, and in 1876 a portion of Pennsylvania avenue, Washington, D. C., was paved with it. Its extensive use in America is prevented, first, because of the heavy freight charges from Europe, and secondly, because of the invention by DeSmedt, of the American form of sheet asphalt pavement, when he laid his first piece on William street, Newark, N. J., in 1871, then in other cities, and in 1876 on a portion of Pennsylvania avenue, Washington, D. C., where his artificial composition of sand, limestone powder, and asphalt cement proved successful. This American substitute and rivalry rapidly spread to all important cities and many smaller ones of America, and has been used to a limited extent in other countries.

The rock asphalt pavement of Europe must be transported in its entirety from the quarries to the city where used. Freight, therefore, is a large factor in its cost and confines its use within certain freight radii of the various deposits where the asphaltic limestone is found. On the other hand, the American system uses sand, found generally near the cities, and requires transportation of the asphalt cement only, which composes about ten per cent. of the weight of the pavement. The rock asphalt deposits of America are so isolated from large cities that there is relatively little demand for compressed, asphalt-limestone pavements, altho a few have been laid with American asphaltic limestone in a few cities in or near Utah and Texas, where there are some rock asphalts, similar but not exactly like those of Europe.

3. *Sources of Supply and Composition.*—The following tables will enable you to grasp quickly the classification of various bitumens and the relative positions of rock asphalts, both bituminous limestone and bituminous sandstone. Kindly remember it is bituminous limestone we are considering.

The countries where asphalt limestone is found are shown in the first part of Table II. The principal sources of supply during the past two hundred years are at various deposits or quarries located in France, Italy, Sicily, Germany, Switzerland, and Russia, within a long belt of limestone, at points where the limestone is impregnated or saturated with asphaltum. In a general paper of the kind I am presenting, it is not necessary to enumerate all of the many large and small quarries of rock asphalt which have been opened and are in use in Europe and the few elsewhere. Table III gives the locations of typical, operated deposits in Germany, France, Italy, Sicily, Switzerland, Spain, Russia, and of two of the three in Oklahoma, Utah and Texas. Table III also gives chemical analyses of samples from each of them. It must be remembered, however, that the per cent. of asphaltum or bitumen in the asphalt rock in each deposit varies somewhat from the samples analyzed, according to the portion of the quarry from which the sample is taken. There are other deposits in the countries named, but those enumerated are sufficient to illustrate the principles before us.

4. *Methods of Obtaining or Quarrying. Preparation and Shipping.*—The methods of obtaining the crude material are the usual ones, with certain variations, used in quarrying any limestone. At some of the deposits where warm weather makes it difficult to drill or bore holes for blasting or breaking out the rock asphalt, due to the adhesiveness and gummy nature of this rock when warm, the mining or quarrying is carried on in drifts or tunnels underground. In such places quarrying in cold weather is in the open.

The rock is shipped either in broken lumps or in ground, powdered form, according to the distance to be shipped, or as ordered. The customs duty from one country to another varies whether the rock is in lumps or labor has been paid to powder it. Previous to use for almost all purposes to which rock asphalt is applied, it is crushed, generally in special-toothed rolls, altho in cold weather jaw-crushers can be used. It is then reduced to powdered form by centrifugal pulverizing machines or sometimes by special flail or beating machines.

If used for compressed sheet asphalt pavements, rock must be selected having a uniform and requisite per cent. of bitumen in it suitable for the climate, traffic, and slightly different rock from different quarries. It is customary to blend the rock when necessary from parts of a quarry or from different quarries to get the desired results. For paving streets, the powdered rock, in its natural state, is warmed at the place where it is to be used for asphalt pavement for vehicle and other heavy traffic, or for other uses where this compressed, solid form of rock

TABLE I. CHARACTER AND LOCATION OF NATURAL BITUMENS AND COMPOUNDS

	Bitumen	Character	Where Found
Important Bitumens and Compounds.	Natural gas.	Gaseous.	North America, South America, Europe, Asia.
	Natural naphtha.	Thin fluid.	North America, South America, Europe.
	Petrolcum.	Thick, oily.	North America, South America, Europe, Asia.
	Maltha & compounds.	Soft at 77°F., called also "Soft Asphalt."	N. Amer., S. Amer., Europe, Asia, Africa, Australia.
	Asphaltum & compounds.	Stiff at 77°F., "Hard Mineral Pitch."	N. Amer., S. Amer., Europe, Asia, Africa.
	Glance pitch.	Brittle at 77°F., "Mineral Pitch."	North America, S. America, Asia, Africa.
	Elaterite.	Elastic, "Mineral Rubber."	North America, South America, Europe, Asia.
	Ozocerite.	"Mineral Wax."	North America, Europe, Asia.

TABLE II. ROCK ASPHALT

Compounded with Limestone. (Containing Silicates, etc.) Found in Austria, Cuba, France, Germany, Hungary, Italy, Russia, Sicily, Spain, Switzerland, Turkey and United States.

Compounded with Sandstone. (Containing Carbonate of Lime, etc.) Found in France, Germany, Italy, Russia, Sicily, Spain, Turkey, United States, Alaska and Canada.

Table III. ANALYSES OF BITUMINOUS LIMESTONES (ROCK ASPHALT).

	Germany			France		Italy		Sicily	Switzerland	Spain	United States		Russia
	Limmer	Lobsan	Vor Wohle	Seyssel	Mons	St. Valentino	Cesi	Ragusa	Val de Travers	Maestu	Utah	Texas	Syran
Asphaltum	14.30	12.32	8,50	8.15	10.20	8.83	7.15	8.92	10.15	8.80	36.28	11.65	30.50
Carbonate of Lime	67.00	71.43	80.04	91.30	84.63	80.00	73.76	88.21	88.40	9.15	29.52	.03	66.23
Sand	....	3,15	....	....	....	....	14.24	.60	....	68.75	6.46	88.32	....
Aluminum and Iron	....	5.91	....	.15	....	....	....	.91	.25	4.35	27.44	....	....
Sulphur	....	5.18	4.03	....	....	....	3.02	....	....	....	....	....	....
Magnesium-Carbonate	17.52	.31	.55	.10	....	....	....	.96	.30	8.10	....	....	3.27
Insoluble in Acid (h.cl.)	....	....	4.77	.10	....	....	.10	....	.45	....	....	....	....
Undetermined	1.18	1.70	2.11	.20	5.17	11.17	1.73	.40	.45	.85	.30	....	....
Total	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.	100.

NOTE—The materials vary somewhat from each deposit.

asphalt is required. The warmed material is spread upon a suitable foundation and compressed by ramming with hot, heavy, iron rammers, which condense the material to the necessary density and solidity. The surface of the pavement is smoothed with hot smoothing-irons, which must not be so hot as to burn the bitumen in it. A heated, heavy, hand-roller is also used to smooth out any indentations left by the rammers. Subsequent to its first construction, such rock asphalt pavements are further compressed a little by traffic. The result is a dense, durable, waterproof, monolithic pavement, which, with reasonable maintenance, can be kept in constant good order indefinitely.

If the rock asphalt is to be used for making asphalt-mastic, then it is heated for several hours in revolving, large, mixing cylinders, into which is introduced some pure or relatively pure asphaltum or asphalt cement, from other sources. The result is that the natural bituminous limestone has its bitumen enriched until the per cent. in the asphalt-mastic is raised to the amount desired, generally about 20 per cent. This mastic, while hot, is run into forms or molds, so that the mastic is shipped all over the world in cakes of different forms and with different brands, according to the source of the supply or manufacturer.

The asphalt-mastic, on arrival at the place to be used, is melted in special kettles, at the same time mixing with it some more asphaltum or asphalt cement, and adding suitable sand and sometimes very fine gravel, according to the purposes or uses intended.

5. *Uses.*—The two principal uses of natural asphaltic limestone, called also bituminous limestone and rock asphalt, are for constructing the wearing surface layers of sheet asphalt pavements for streets and equivalent requirements; also for manufacturing rock asphalt-mastic for use in various compounds for sidewalks, floors, roofs, decks, waterproof linings, damp course, pavement of bridges, etc. It is used all over the world in breweries, sheep, pig and cattle pens, cellars, coach-houses, conservatories, grain houses, courtyards, fish markets, warehouses, gunpowder magazines, laundries, lavatories, malt houses, markets, railway platforms, freight houses, playgrounds, slaughter houses, stables, wash houses, etc. It meets conditions where surfaces are needed which will not crack or deform from expansion and contraction of heat and cold or from slight settlements and deformation of floors, foundations, and structures, which surfaces at the same time resist moisture and the wear of foot and other light traffic.

It is not the province of this paper to go into the many and minute details of technical preparation and methods of use for each of the many applications of rock asphalt. The industry is large and its subdivisions too many to be presented otherwise than in the several available publications on the subject, the authors of which I have named.

The most successful use of bituminous limestone depends principally upon the selection of a good quality of natural rock and practical experience in handling it. Experienced foremen and trained laborers in this industry are available almost everywhere.

Fibered Asphalt Pavement

Nearly two years ago a small area of pavement was laid by the Memphis Asphalt Paving Co., using a mixture of woody fibre, from which all chemically active ingredients had been removed, and Trinidad asphalt. This pavement was thoroly rolled with a heavy roller and has successfully withstood the many heavy loads passing over it daily to and from several manufacturing and commercial establishments as well as the climatic changes of that latitude.

A few weeks ago a few square yards were laid on a part of a street intersection in the city of Indianapolis, which has behaved itself well in the heat of an unusual summer. Still later some patches were laid with the same woody fiber mixed, part with California asphalt and part with California asphalt and some pounds of stone dust. These patches were not fully compacted, the roller used being a small asphalt repair roller.

Part of the patches made with the mixture of asphalt and fiber without stone dust did not keep their places but part of them have, and the mixture of stone dust seems to have produced a hardness in the patches where it was used which is similar to that in the earlier mixtures of fiber and Trinidad asphalt, so that these patches are holding up well.

All these sections of the experimental pavement are under close observation and their condition will be reported from time to time. So far the indications are that a promising new material has been found which will probably be able to compete in price, at least as long as the supply of fiber can be kept up, with other pavements of equal quality and resistance to traffic. The point made by the originators of the pavement is the inherent stability due to the action of the fibrous material in the mixture in resisting change in form or consistency. Trinidad asphalt offers the inorganic matter thus far indicated to be necessary to produce proper co-operation of bitumen and fiber.

Lighting

High-Pressure Gas for Street Illumination

HGH pressure gas illumination for important streets has been extremely successful in London, Paris, Berlin and large provincial towns such as Birmingham; in several cases the installations have been less successful; it may therefore be interesting to draw attention to only partial success, in order that the system, wherever introduced, may always give the best results possible.

All the practical advantages claimed for electric lighting, such as simplicity of switching operations, possibility of dispensing with lamp lighters, great economy of cost, and so on, are actually obtained by the use of gas high pressure installation.

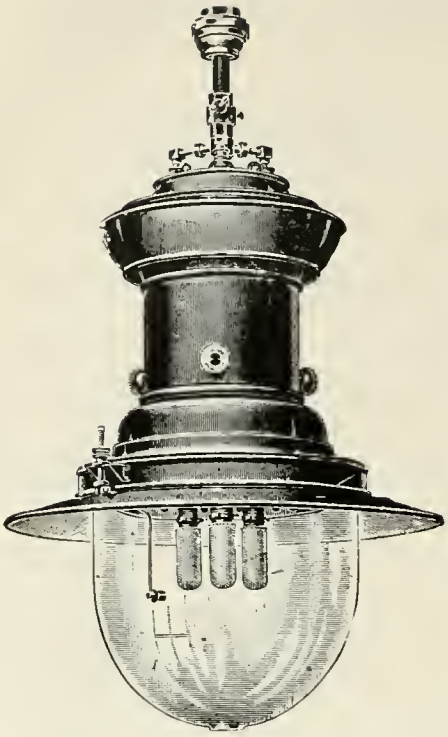
A complaint of extensive and highly dangerous leakage of high pressure gas is only made possible by neglect on the part of main-layers and is easily avoidable. All mains, after being laid, must be made subject to severe tests and any subsidence prevented by bedding the mains where necessary on a foundation of concrete.

No detrimental effect is caused by foggy or heavily smoke-laden atmosphere on the gas mantles, resulting in any diminution of candle-power. Ordinary foggy weather does not affect them at all, also not the ordinary smoke of a manufacturing district. During extraordinarily bad weather street lamps may be burning both day and night, thus eliminating any remote possibility of smoke settling on the mantles. It is also important to note that the rays of gas lamps penetrate fog considerably better than those of electric lamps.

The great objection to electric street lighting is the intense glare of the arc lamps, which electrical experts are anxious to reduce, as it tells against their system. In this respect gas lamps are superior for the eyes, because the source of light is immensely larger than the arc of the electric lamp.

There is still ample scope for both gas and electric light engineers to experiment with the object of improving the distribution of light. Such experiments, if they resulted in nothing else, would also probably lead to improvements tending to lengthen the effective life of the gas mantles, which are at present insufficiently protected from the weather. Some experts assert that all sources of light should be screened down so that their intrinsic brilliancy does not exceed that of the sky, which has been estimated at about three candle power per square inch.

The measurement of light and illumination has now become a science, the degree of accuracy of which is only limited by the personal error of the observers using the photometric instruments. Street photometry can be practiced within an accuracy of 5 per cent. of the direct candle-power measurements and within 7 per cent. of the horizontal illumination measurements. To measure the illuminating effect of high pressure gas lamps a portable photometer may be used for rough measurements, fitted with a Bunsen screen; also the type known in Europe as the universal photometer, the accuracy of which is very high, as the flicker attachment is used for direct measurements, thus reducing to a minimum any error due to variation in color of light sources. The artificial illumination of streets being carried out by means of light sources fixed at intervals along a street, results in a varying degree of illumination, depending on the distance from the light sources and as that illumination is proportionate, not to the distance only, but to the square of the distance and the angle at which the light falls on the surface, it will readily be seen that much depends not only on the candle power of the lamps, but even more on the way they are spaced along the street and the height at which they are erected. With the object of bringing all the factors, namely, candle-power, distance and height into a common factor for comparison, it is becoming the practice to compare the illumination of streets by ascertaining the minimum horizontal illumination at any part of the street on a screen three feet



KEITH'S HIGH PRESSURE GAS LAMP, *giving* 2,000 *to* 4,500 *candle power with steel reflectors.*

above the ground level. This minimum factor is considered the important one, as it embodies all others, also because if the minimum illumination is sufficient for the pedestrian and road traffic, the illumination thruout the remainder of the street must be sufficient.

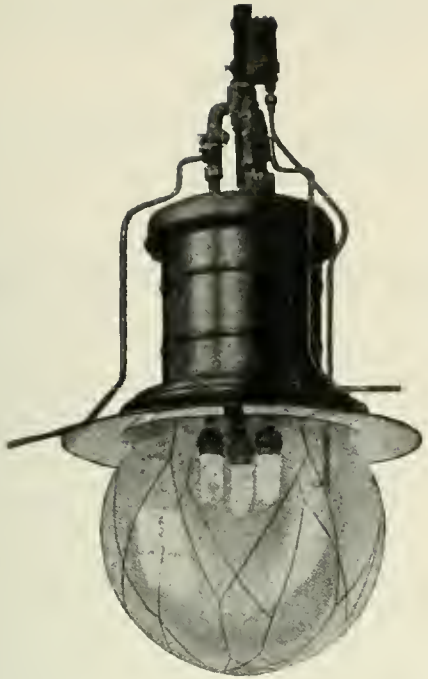
In order to test high pressure gas illumination of streets satisfactorily, a series of tests should be made extending over a period of several weeks, including photometric measurements of candle-power and illumination, which should be carried out every consecutive night, weather permitting. Periodic measurements of the gas consumption and gas pressure should be made to check those recorded by the gas meters and recorders installed. Whilst tests are being made, the lamps in the street under examination must be operated precisely in the manner usual in ordinary practice; adjustments and alterations being only permitted when found to be absolutely necessary.

The following details of actual tests made on high pressure gas street lamps will give point to what has been stated above. The lights tested are known as the Keith high-pressure gas lanterns, each containing three inverted high-pressure mantles, supplied with gas raised to a pressure of 55 to 60 inches of water by means of a compressor plant placed in an adjoining street; the pumps of which of which were driven by electric motors.

The lamps were suspended from span wires. A tower ladder was used to adjust, trim and clean the lamps. Lowering gear could alternatively be used. The central hanging of light sources has many advantages to recommend it, where powerful light units are necessary, as in very busy thorofares. The most important are that the lamps can be erected at a considerable height, so that they do not come into the line of vision of either pedestrians or drivers of vehicles using the street; furthermore, the lighting of the footpaths is much more even than when the light sources are carried on poles erected at the edges of the footways. A further advantage is, that poles being rarely needed for supporting the span wires, the footway is freer from obstacles to the traffic. The only serious disadvantage is the inaccessibility of the lamps. In the case of high pressure gas lamps, the lowering gear may cause trouble with the joints. It has, therefore, been suggested that the lamps could be supported from brackets attached to the buildings.

The average height of the lamps tested was 26 feet 6 inches and the average distance apart 107 feet; that would mean 49 lamps to the mile of street. Most of the photometric measurements were made at the following angles: For the maximum illumination from the rays 45 degrees from the horizontal and for the minimum 20 to 25 degrees from the horizontal. Very numerous measurements, extending over several weeks, gave the following results: Average candle power at 20 to 25 degrees from the horizontal, 1,750; average at 45 degrees from the horizontal, 1,670. Average minimum horizontal illumination derived therefrom on the pavement, 0.39 ft. candles; the average maximum horizontal illumination on the pavement, 1.9 ft. candles.

The costs, excluding capital charges on lamps and special mains, were made up as follows: Of the cost of low pressure gas delivered to the compressor, plus the cost of compressing, the cost of mantles and renewable parts, labor charges of lighting, extinguishing and renewing parts. The cost of the low-pressure gas delivered at the compressor station amounted to 25 cents per 1,000 cubic feet, to which has to be added the cost of compressing, 4 cents per 1,000 cubic feet, making a total cost of 29 cents per 1,000 cubic feet, delivered into the high pres-



GAS FOR STREET LIGHTING. *Welsbach lamp producing sixty candle power per cubic foet of gas burned.*

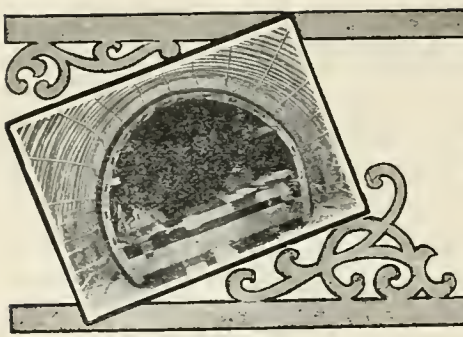
sure mains. Careful consumption tests showed that the consumption per mantle was 26.5 cu. ft. per hour; equal to 79.5 cu. ft. per hour for each lamp, giving a cost per hour for high pressure gas of 2.294 cents per hour. To this must be added the cost of mantles, globes and labor, making the total 3 cents per hour. The capital cost of plant and apparatus, including lamps, lanterns, poles, suspension and all accessories, amounted to $240 per lantern, apart from cost of the high pressure gas mains and compressor plant. The capital cost per mile of street would, therefore, amount to $11,760. During the time the tests were being made the maximum variations of any one gas lamp were from 2,058 candle power to 686 candle power, and for all the gas lamps tested, from 2,475 candle power to 686 candle power. It was stated above that the gas lamps cost three cents per hour, equal to $60 per lamp per annum of 2,000 hours. That would amount to a cost of $3,240 per mile of street; the capital costs per mile of street would amount to $12,177.60.

High pressure gas lamps used for street lighting, have on occasion been found not to give the full results expected, thru not being properly installed or adjusted. It is of extreme importance that the correct height should be ascertained. The height given above, 26 feet 6 inches, is too great to yield the best results, it only gave 27 candles per cubic foot of gas; when placed at a more suitable height the efficiency should be at least 50 candles. Lamps placed at a height of 20 feet, with only two burners, adjusted to a proper efficiency, would give a light equal to, if not better, than the three-burner lamps discussed above. The life of a mantle was found to be 400 hours, therefore each three-burner lamp would require 15 mantles per annum of 2,000 hours. The capital outlay has been found to be as follows: Per lamp, $58; for installing same, wages, poles, suspension gear and other smaller items, $180. To obtain the lowest working cost it is necessary that the compression should be worked to its full capacity. The cost given above for compression is too high because the compressor was not worked to its full load. The flexible connection to a high-pressure gas lamp requires careful watching, it may be faulty and occasion loss of either pressure or gas.

Fire Protection at the Panama-California Exposition

The Seagrave Company, of Columbus, Ohio, has been awarded the contract for supplying the Panama-California Exposition at San Diego, with its fire-fighting apparatus, and has started installation to add to the equipment which has been on the grounds since the construction started. The fire station, of Spanish Colonial architecture like the entire colony of buildings on the high mesa overlooking the sea, was the first structure to be erected, following the administration building and the hospital. Thus far its labors have been light, as the exposition forbade smoking during the construction period and went to other extraordinary precautions to prevent fire.

Several of the big buildings are entirely of steel and concrete, stone and tile. The others are of staff and plaster finish, which in a climate such as that of San Diego, will have a life of thirty years or more, as there is no frost or sudden change of temperature. For this reason as well as for the protection of the valuable exhibits during the year of 1915 there has been close attention to safeguard against fire.



CIVIC ADVANCE

Chicago Municipal Markets

The report of the Chicago Municipal Markets Commission, of which Alderman Jas. H. Lawley, is chairman, gives quite a discussion of the high cost of living, showing from reports of the U. S. Commissioner of Labor the large increase in the last 21 years.

The utter inadequacy of Chicago markets is shown. They consist of the South Water street commission house district, the West Randolph street producer's market, which is mainly wholesale, and the Maxwell street peddlers' market, both wholesale and retail, and mainly foreigners as to customers. There are but few private markets. These markets have no effect on prices to consumers, the prices of retailers running from one-sixth larger to nearly six times as great as those paid to the producers. The average payment by the consumer is divided in the proportion of $1 to the producer, 13 cents for freight, and 77 cents to the middlemen, quite too high an expense of distribution. This expense is shown to be due largely to the speculative system of distribution of farm products thru commission merchants, jobbers, retailers and hucksters, and the excess in the number of men engaged in this distribution. Duplication in hauling to and from central distribution points is another largely unnecessary increase in expense; also loss due to lack of storage facilities and consequent spoiling of perishables. Scattering of railroad terminals is another source of waste, as well as delay in placing of cars.

The commission business is considered out of date. Selling goods wholesale at auction is recommended as advantageous to the producer.

The retail business is done in a very inefficient manner with strong competition and probably twice as many engaged as are needed. Far too many wagons are engaged in delivery, duplication of routes many times over by wagons from different stores being common.

Chicago and San Francisco are the only cities of over 300,000 population which make no expenditures on municipal markets and public scales. The value of land buildings and equipment in the other sixteen cities of that class varies from $713 in Minneapolis, to $7,988,742 in New York, ten of the eighteen cities having more than $500,000 invested.

The summary of the recommendations of the commission is as follows:

1. Chicago's present market facilities are merely private trading centers where middlemen and speculators congregate. These markets, as now constituted, are entirely inadequate, insanitary and extremely wasteful. The city should proceed to formulate plans and proposals for a comprehensive system of wholesale terminal markets under the control of the city, designed to render efficient and satisfactory service to the consuming public.

2. Retail markets should be established by the city wherever private retailers, by excessive and unreasonable prices or an unwholesome food supply, fail to render satisfactory service to the economically weaker part of the city's population.

3. Farmers' markets held in open or covered public places adjacent to centers of population should be established and in such other sections where bodies of consumers may apply for them. These farmers' markets should be made accessible to producers for the sale of articles of fresh garden truck and other staple commodities to the consumer direct.

4. Peddlers, hucksters and push carts are an economic necessity and tend greatly to reduce the high cost of living to the people living in certain sections of the city. Vending of food supplies by these classes should be considered an established and legitimate business and, inasmuch as these classes are able to sell food products to the consumer at greatly reduced prices over the prices prevailing at the retail store, due to the low operating costs of the former, such business as conducted by peddlers, hucksters and push cart men should be encouraged by the municipal authorities.

It has been found that the quality of the food and merchandise sold from push carts in New York City is in the main of as good quality as can be bought anywhere else in the city, and much cheaper. Your Commission believes that a decided service will be rendered to certain classes of our citizenship by peddlers, hucksters and push cart men and that their business should be subjected only to certain necessary sanitary and police regulations and such rules as may be required to prevent undue congestion of vehicle traffic in our streets.

5. Complaint has been made that scalpers have adopted a system of meeting the farmer on his way to the West Randolph Street market in busy seasons at the city limits and purchasing his entire lot of produce. The scalper increases the price of the product at the market and the public has to pay the increased cost. The present ordinance limiting the use of the West Randolph Street market to producers alone should be rigidly enforced.

6. The market hours in the West Randolph Street market should be changed from the present prevailing hours of opening at 10 o'clock a. m. and closing at 2 p. m. from November 1 to May 1 and opening at 4 o'clock a. m. and closing at 10 o'clock a. m. from May 1 to November 1, so that the market hours during the entire year shall be from 4 a. m. until 5 p. m. daily, excepting, Saturday, when the market hours shall be from 4 a. m. until 10:30 p. m.

It has been stated that a large number of consumers at present frequent the South Water Street and West Randolph Street markets daily, and especially on Saturdays, in order to make retail purchases of food supplies at the only places in the city of Chicago where the cost of food is presumably lowest, despite the present unfavorable conditions prevailing in these markets for the making of such purchases at retail.

These hours as recommended, it is believed, will cause the consumer to take an added interest in the public markets at present provided in the city of Chicago and enable him to buy on the markets at convenient hours.

7. An ordinance should be passed by the Chicago City Council requiring all persons, firms or corporations in the city receiving farm produce of any kind for sale on commission to keep a complete record of the amount and kind of such produce received and of the sales made and the prices received, together with the dates of the receipts and sales and the names and addresses of the shipper and purchaser, and that this record shall be open to the inspection of the shipper or the consignor of commodities and to official inspection by the city. Commission merchants should also be required to take out a license from the proper city department and to give adequate bonds of surety for the faithful performance of their work and the sanitary operation of their places of business. Should it be shown that any person doing a commission business in the city has been guilty of fraud, deceit, unlawful practices or conducts his business of handling food supplies in an insanitary manner, provision should be made in the ordinance for the revocation of the license so that such person can no longer carry on a commission business in the city of Chicago. This will serve as an ample protection to the producer and the consumer and will require commission men to deal fairly with both.

8. A city tribunal should be created in the recently established Department of Public Welfare, before which any person may lay a complaint of injustice or unfair treatment incurred in the distribution of food supplies. Such tribunal could investigate all charges made against producers, wholesalers and retailers and will be of invaluable service in investigating any charges that may be made relative to corners in food supplies, combinations in restraint of trade, storage of surplus products by jobbers and other agencies and extortionate prices.

9. In order to give the producer direct access to the markets of the city and to furnish the Chicago consumer with fresher and a more varied allotment of farm products, trolley freight service should be placed in operation over the present existing street railway lines, and the interurban street railways should be given direct access to the city markets and to such other points in the city convenient to the consuming public for the delivery of fruits, vegetables and dairy products. The rapid and easy access to the city markets and to such other points in the city convenient to the consuming public for the delivery of fruits, vegetables and dairy products. The rapid and easy access to the new markets achieved by the establishment of street railway freight service to and from the city will encourage production, and the vast amount of land near the city of Chicago at present undeveloped will be divided into small truck, poultry, dairy and fruit farms. The time has arrived when our urban and interurban street railways should be operated for the benefit of the community in shortening the route between the producer of farm products and the consumer. The carrying of freight by street railway lines inside of the city limits, however, should not be permitted to interfere with the proper handling of the passenger

traffic. Such freight cars should be operated during the hours when the passenger service is at a minimum and practically at a standstill and they should be kept out of the congested district of the city. Freight handled by the interurban street railways could be carried over the Chicago street railways between the hours of 11 p. m. and 5 a. m. without inconvenience to the public. By permitting our street cars to carry freight during the night, street congestion in the day time will be lessened to a large extent by the elimination of a large amount of hauling by teams.

10. It is the sense of the Commission that no private movement for the establishment of improved market facilities in Chicago should be conducted separately from the action contemplated by the city at this time thru the investigation being conducted at present by this Commission. It is believed that no reliable decision conducive to the general public welfare can be made by the classes most directly interested in exploiting a private wholesale terminal market for their own profit. The strategic point to the city upon which the control of its food supply is pivoted is the wholesale terminal market. The entire project under way by the South Water Street merchants for the establishment of such private wholesale terminal market should be held in abeyance pending a careful, adequate and expert inquiry to be made by the Citizens' Terminal Plan Committee of the city of Chicago, the Chicago Plan Commission and the Chicago Municipal Markets Commission for the purpose of devising comprehensive plans and proposals which will serve the future growth and development of the city as a whole and further the best interests of the community.

The Birmingham Water Works Controversy

James Weatherly, one of the city commissioners of Birmingham, Ala., brought suit against the Birmingham Water Company for annulment of its charter on the ground of breaches of its contract, particularly as to the quality of water furnished.

This case was recently decided by Judge Crow, of the Jefferson County circuit court, to the effect that the conduct of the water company did not justify a forfeiture of its franchise. One peculiarity of the decision is that an ordinance purporting to fix rates, under which the company has been acting, apparently under protest, is declared invalid and the company is ordered to go back to former flat rates, which are higher than those at present in use.

The water company has issued two booklets, one giving a review of the entire controversy and a new proposition to the city, dated July 15, and the other a statement to patrons explaining the effect of the recent decision and the rates it requires the company to charge.

The matter has been injected into the campaign for election of a city commissioner, in which Mr. Weatherly is a candidate.

The city engineer, Julian Kendrick, has made an estimate of the cost of constructing an entirely new municipal plant, practically $4,500,000.

The company's proposition proposes a rearrangement of existing contracts whereby the rates will remain as they have been under the ordinance just decided invalid; further reduction will be made in minimum rates and by abolition of charge for making service connections; and provisions for purchase of the plant by the city are made.

It is unfortunate that such questions as this should be used as political capital in election campaigns rather than settled by experts according to their merits on general lines determined, if desirable, by popular vote.

Municipal Notes

Personal Responsibility for Fires

J. O. Hammitt, chief of the Fire Prevention Bureau of New York City, favors the enforcement of personal responsibility for damages from fire, and urges that property owners whose carelessness is responsible for fires should be made to pay at least the cost to the municipality of fighting the fire. Along this line, Mr. Hammitt said, in an address before the municipal officers of New York State:

"Still another thing we have attempted in New York is of special interest to the other cities. Perhaps you know that in some foreign countries a man on whose premises a fire is started is frequently held responsible for the cost of extinguishing the fire and also for damage to the property of others. I do not know exactly how the laws under which this responsibility is fixed in foreign countries are phrased, but we have in the Greater New York Charter a provision under which we think that if a fire occurs or spreads because of the absence of precautions required by law or by lawful orders of the Fire Commissioner, the owner of the premises or person responsible for the violation is liable for the cost of putting out the fire, and for injuries to firemen sustained in fighting it.

"No suit had ever been brought under this section of our City Charter till the present Fire Commissioner, Robert Adamson, went into office. We had a disastrous smoke fire in the cellar of a loft building. It could easily have been extinguished by a single company without danger to the firemen if an order of the Bureau of Fire Prevention for the installation of a sprinkler equipment had been complied with. Because of failure to comply with this order, Commissioner Adamson holds that the Greenwood Cemetery Corporation, which owns the building, is responsible for the cost of putting out the fire; and he has brought suit to recover. We expect to bring suit also for the injuries to the firemen. Perhaps if we succeed it will be clearly established that the Greenwood Cemetery Corporation must indemnify all those who suffered loss in the fire. Once that is established, many people will be more careful."

Dayton Under A City Manager

Dayton, Ohio, completed July 1 its first six months under the commission-manager plan of government, and the city manager has issued a statement of new municipal activities during this period. The report covers only sixteen pages and is exceptional in that it tells only of new work undertaken.

Dayton with 125,000 people expects in 20 years to have a population of 200,000, and is planning accordingly. A sewer system has been outlined with this growth in view and all new sewers are being laid to this program, altho it will take 20 years to complete the system. Water works improvements have been started on which it is proposed to expend $2,000,000 over a period of 16 years. The railroads are preparing a plan for eliminating grade crossings which will take a number of years to carry out.

The manager's report indicates that this new type of government, modeled after that of private business, has brought about some valuable improvements, particularly in the handling of public money. The purchasing division just created shows an average saving of 15 per cent., which will amount to $20,000 during the year. An accounting system has been installed which gives complete control over public property and funds. The annual budget was prepared in accordance with the best modern practice, and expenditures are kept strictly within the appropriations. The eight-hour day has been installed in public works and office employes are required to work the full time. No person from the manager down to the last employe can be paid unless a time sheet has been kept showing the number of hours worked.

In the welfare department the death rate of babies has been cut exactly in two, by adequate health service, the es-

tablishment of free clinics and pure milk stations. Two large parks have been opened to the public with bathing, boating and other amusements. A number of loan sharks have been compelled to revise the schedules to meet legal requirements, and a legal aid bureau established for giving free advice to the poor. Prisoners in the work house are used in the improvement of city parks, community gardens and any other public works, being paroled on their honor. Three women probation officers have been appointed, a school for police has been established, and the methods of the fire and police divisions have been investigated and reorganized.

The Dayton Bureau of Municipal Research has published the manager's report for free distribution.

Transportation Facilities of Buenos Aires

The city of Buenos Aires, now in the million population class, is well covered with electric trolley lines so that it is quite easy to get about. When the new subway between the main centers of business and official activity is supplemented according to plans, the transportation facilities will be almost ideal under the local conditions of traffic.

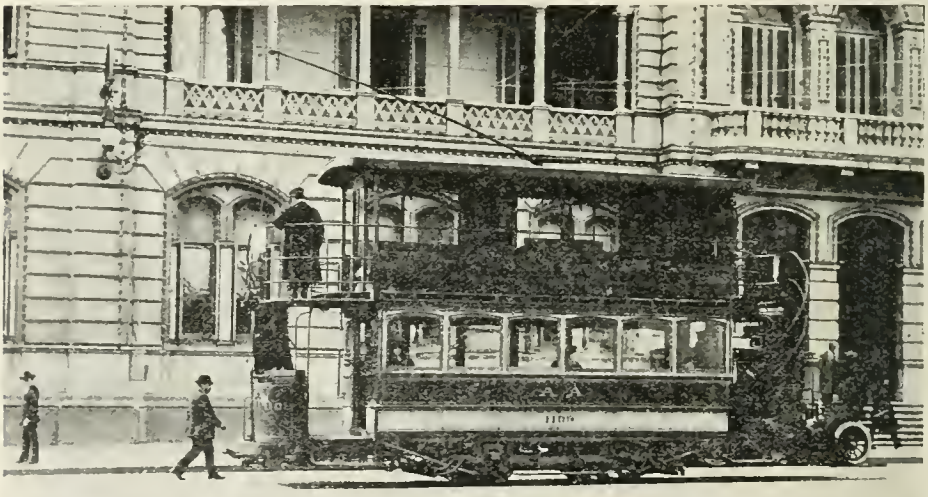
The accompanying illustration shows a double-decked street car in front of one of the handsome buildings and on one of the well-improved streets which aid in giving it the name of the Paris of America,

The upper deck is quite as complete a car as the lower, with front and rear entrances and steps, and enables one to take the air and see the city with ease and comfort. Seats are set back-to-back so that the view on one side of the car is unobstructed.

Fares are a pleasurable contrast to most charges in Buenos Aires; about the equivalent of four cents in our coinage will carry a passenger almost from one end of the city to the other.

The facilities which these trolley cars afford are very great indeed, yet, there are times when the pedestrian, especially if he be a stranger to the city, feels that perhaps such ponderous vehicles might he dispensed with. The streets of Buenos Aires are, in general, rather narrow, so that in order to leave room for other traffic, the trolley tracks are often laid within a foot or two of the curb. One might be walking near the edge of the sidewalk suspecting nothing, when suddenly there comes the vigorous clanking of a bell, a heavy rumble, and the huge body of the car grazes the elbow of the wayfarer as it sweeps past.

This, and the further fact that nearly all the streets of Buenos Aires cross each other at right-angles, requires the cars to approach the crossings very carefully in order to avoid accident.



DOUBLE DECK TROLLEY CAR *in Buenos Aires, Argentine Republic. Note also excellence of asphalt pavement.*

MISCELLANEOUS

The Buffalo Brick Convention

On September 9, 10 and 11 the National Paving Brick Manufacturers' Association will hold its annual meeting at the Statler Hotel, Buffalo, N. Y. The business of the convention proper will be completed as early as possible on the 9th and will be followed by a conference with members of the sub-committee of the American Society of Municipal Improvements on standard specifications for brick paving.

Two inspection trips over the new state highways in the neighborhood of Buffalo will be taken on the 10th and 11th, the first to the southeast and south of Buffalo with lunch at the Roycroft Inn, and the second over the largest and broadest brick highway yet constructed, from Buffalo to Fort Niagara, with the afternoon devoted to Niagara Falls. A banquet on Thursday night will bring everybody together.

A number of highway commissioners and engineers have been invited to the convention and those who attended the meeting at Cleveland last year or who have heard of it will be sure to be present this year. The officers and members of the association are princely entertainers and there is no lack of value either technically or socially.

Recent Charter Elections

Several large cities have voted recently on the question of charter revision with various results.

Cincinnati rejected a plan similar in principle to that in use in Boston.

Seattle rejected a plan similar in most essentials to that in operation in Dayton, the principal objection of the voters being to the council elected by wards, with thirty members.

St. Louis adopted its new charter, retaining good principles in its old charter and reducing the men to be voted for to mayor, controller, president of board of aldermen and twenty-eight aldermen. Initiative, referendum and recall are included and non-partisan elections and preferential voting will be subject of a referendum later.

Buffalo has finally secured the passage by the legislature of its charter providing the commission form of government and will shortly vote upon its adoption by the people.

Orange and Irvington, N. J., Bloomington, Ill., Fond du Lac, Wis., Greenwood, Miss., and Palatka, Fla., have adopted the commission form of government; Kansas City, Mo., Collingwood and Kearney, N. J., and Platte, S. D., have rejected it.

Olean, N. Y., Marion and Mulberry, Kan., and Roswell, N. M., have adopted the city-manager plan.

A Much Greater New York

Dr. T. Kennard Thomson, in an address before the Maritime Association of the Port of New York, explained a project shown in the accompanying sketch in which the hatched portions indicate the reclaimed land.

Briefly the scheme advocated by Dr. Thomson involves:

A New East River from Flushing to Jamaica Bays.

A dam at Hell Gate.

A new Harlem River.

Reclaiming the East River from Hell Gate to the Battery.

A new neck of land from the Battery to within a mile of Staten Island.

Tunnel to Staten Island.

A New Bay between Sandy Hook and Staten Island and forty square miles of new land therein.

Connecting these forty square miles by tunnels to Staten Island and Sandy Hook.

Reclaiming the land shown on the Jersey shore.

Developing Newark Bay for a Navy Yard, etc.

The would result in the addition of 100 miles of new water-front for docks, etc.; the reclamation of 50 square miles of land; New York City Hall the center of a greater New York whose radius will

be 25 miles; payment of the debts of the City and State of New York and increase in the prosperity of the whole country.

The rivers and harbors are becoming veritable cesspools. The elaborate plans of the Metropolitan Sewerage Commission are designed, not to improve the present conditions, but to prevent them becoming very much worse.

The proposed plan will make it possible to run great trunk sewers from White Plains down where the East River now is, thence to Staten Island, picking up all the Jersey sewage, and then on, beyond Sandy Hook, where it can be properly treated.

Magnificent opportunities would be created for Jamaica Bay when it is in direct touch with New York. Staten Island will be put in direct contact with New York; and also with a new and 'Really Greater Pittsburgh,' as this new territory may well be termed, of 40 square miles, with the most magnificent harbor in the world, with all the thousand-foot wharves required and plenty of room for dry docks, repair and ship building shops and all kinds of crafts.

With the new Barge Canal ore can be obtained here as cheaply as in Pittsburgh, making it possible to compete with the world in the manufacture and export of all kinds of goods.

This would permit all the railroads to reach Staten Island, Manhattan, Brooklyn, Queens, etc., quicker and cheaper than they can now reach New Jersey.

In common with other engineers Dr. Thomson considers the project one of finance, the engineering difficulties being but matters of detail.

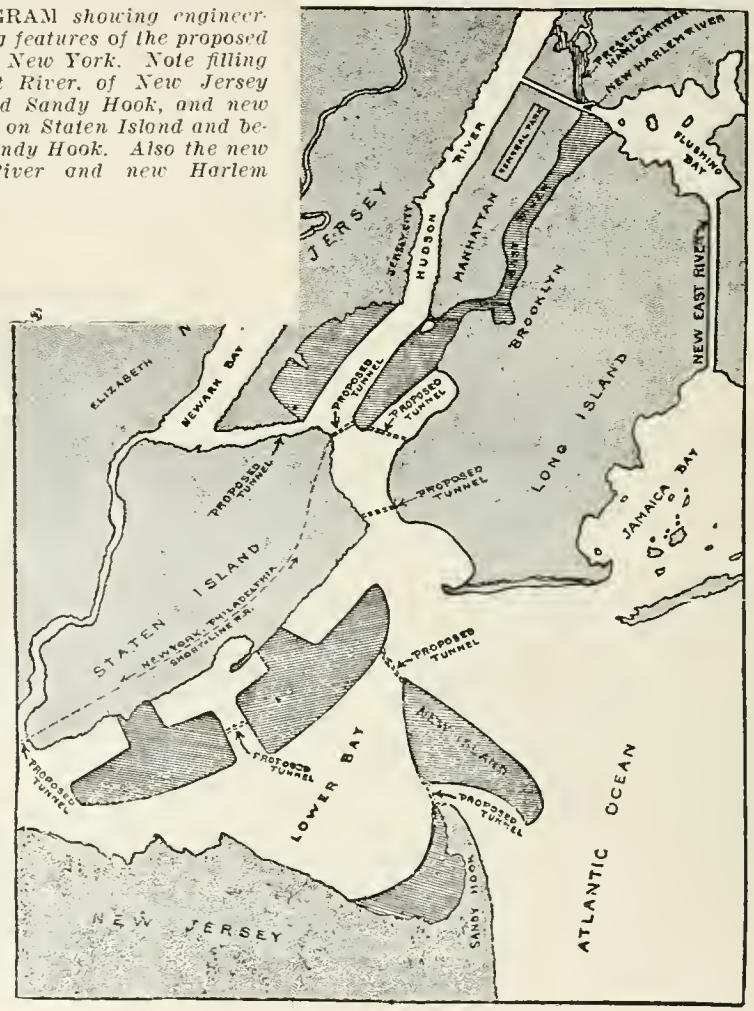


DIAGRAM *showing engineering features of the proposed Greater New York. Note filling of East River, of New Jersey flats and Sandy Hook, and new harbors on Staten Island and behind Sandy Hook. Also the new East River and new Harlem River.*

Trade Opportunities In Other Countries

The *Daily Consular and Trade Reports*, issued by the Bureau of Foreign and Domestic Commerce of the U. S. Department of Commerce, at Washington, D. C., publishes many reports, telegraphic and mail, of opportunities for the sale of goods from the United States in South America or Latin America which are indications of the serious conditions under which those countries are suffering thru the withdrawal of their usual supplies from England, Germany and France, and the consequent search for new sources of supply.

In the light of recent occurrences on this continent which have caused a stronger tendency of American nations to get together, it is natural that these countries should look to the United States for what they want, and that they should take what this country has whether it is exactly what they are accustomed to or not. It is up to our merchants and manufacturers to take care of this trade, which is actually being forced upon them.

The *Daily Consular and Trade Reports* can be subscribed for at $2.50 a year, thru the Superintendent of Documents, Government Printing Office, Washington, D. C.

An appropriation of $50,000 for promoting commerce in Central and South America, the first of the kind, was available July 1 and will be used to reinforce the existing service. Trained agents will study markets for lumber products, hardware, clothing and accessories, and the Gulf of Mexico and Carribean Sea in general. Another appropriation for commercial attaches enables the appointment of promotion agents for the larger ports, Rio de Janeiro, Buenos Aires, Santiago and Lima.

Publications of the Department are obtainable of the Superintendent of Documents, such as the South American Trade Directory and bulletins on many special subjects, in addition to the daily reports mentioned.

Convention of American Society of Municipal Improvements

The American Society of Municipal Improvements will hold its annual convention at the Somerset Hotel, Boston, Mass., on October 6 to 9, with the usual meeting of the Committee on Standard Specifications and the sub-committees on the various paving and sewer specifications on October 5 at 10 o'clock a. m.

The program will be ready for issue in a few days and promises to be more than usually valuable. Advance copies of papers or abstracts will also be issued. These include the following thus far:

"Hints Leading to Good Budget Making for Municipalities," by Wm. Thum, former mayor of Pasadena, Cal.

"Economics of Sewage Filters" and "Limitations of Water Filters," by George W. Fuller, consulting engineer, New York City.

"Municipal Ownership and Operation of Electric Utilities on the Pacific Coast," by C. Wellington Koiner, engineer and superintendent of the municipal electric light and power plant at Pasadena, Cal.

"Street Cleaning," by Edward D. Very, sanitary engineer, New York City.

"The City Efficient," by Louis L. Tribus, consulting engineer, New York City.

"The Effect of Leaking Gas on Bituminous Pavements," by George C. Warren, Boston, Mass.

"The High Temperature Incinerating Plant at Savannah, Ga.," by E. R. Conant, chief engineer of the city.

"The Remodeling of a Small Sewage Disposal Plant at Morristown, N. J.," by Alexander Potter, consulting engineer, New York City.

"Fire Prevention," by J. C. McCabe, boiler inspector, Detroit, Mich.

"The Experimental Sewage Disposal Plant of Brooklyn, N. Y.," by George T. Hammond, engineer in charge.

"Napped, Reclipped, Grouted Granite Block Pavements, the Ideal Economical Pavement for Heavy Traffic Streets," by William A. Howell, engineer of streets, Newark, N. J.

"Recent Tendencies in City Charters," by Nelson P. Lewis, chief engineer of Board of Estimate and Apportionment of New York City.

"Small Parks," by C. D. Pollock, consulting engineer, New York City.

"The Bleeding and Swelling of Long Leaf Pine Paving Block," by Clyde H. Teesdale, in charge of wood preservation, U. S. Forest Products Laboratory, Madison, Wis.

Papers are also promised by I. S. Osborne, in charge of the garbage reduction plant at Toronto, Ont.; S. A. Greeley, civil engineer, Winnetka, Ill.; G. A. Parker, superintendent of Keeney Park, Hartford, Conn.; E. A. Fisher, consulting engineer for Rochester, N. Y.; E. L. Dalton, Dallas, Texas; Norman S. Sprague, superintendent of construction, Department of Public Works, Pittsburg, Pa.

Committee reports on Street Traffic, Fire Prevention and Standard Forms will appear in the advance copy and others are promised. Several of the sub-committees on standard paving specifications are preparing suggestions of changes and additions to the adopted specifications for the purpose of bringing the specifications of the amalgamated A. S. M. I. and A. S. P. S. into complete accord.

But two of the sessions of the convention will be devoted to entertainments and these, in the hands of the local committee, will be instructive as well as entertaining. Charles Carroll Brown, 702 Wulsin Building, Indianapolis, Ind., is secretary, and Joshua Atwood, Boston, Mass., is the chairman of the local committee.

Technical Associations

The Mid-West Cement Show and Convention of the Mid-West Cement Users Association will be held in Omaha, Neb., Auditorium, March 2 to 6, 1915.

The Illuminating Engineering Society will meet at the Hollenden Hotel, Cleveland, O., Sept. 21 to 26. In the long list of papers to be presented are the following of special interest to our readers: "A New Standard Light Source," by L. A. Jones; "Characteristics of Gas-Filled Lamps," by G. M., J. Mackay; "Recent Improvement in Gas Lamps."

The Federation of Trade Press Associations will meet at Congress Hotel, Chicago, Ill., Sept. 24, 25 and 26. E. E. Haight, Secretary, Chicago.

The Thirty-third annual convention of The New England Water Works Association will be held in Boston, Mass., Sept. 9, 10, 11, 1914, at the Copley-Plaza Hotel. The Committee of Arrangements have endeavored to make this convention of particular value to water works superintendents. The program of papers to be presented includes subjects of live interest to the man who is responsible for the daily maintenance and operation of water works. In addition to the reports of committees, which are always valuable features of these conventions, there will be papers on the construction of dams, electrolysis, allowable leakage from water mains, lessons from the Salem fire, the automobile as an efficiency agent in water works management, boiler house troubles, water uses difficult to control, care of gates and hydrants, metering an old city, the Miraflores water purification plant, machine calking of lead joints, public watering stations, low water consumption in Milton, use of the magnetic dipping needle in locating pipes and gates.

The Ohio State Highway Department, the U. S. Office of Public Roads, the Ohio Good Roads Federation and the Highway Pageant and Exhibits Committee co-operate in a pageant and exhibition at the Ohio State Fair in Columbus on Sept. 1, 2, 3 and 4. Five of the models shown by the Government department are shown before shipping to the Panama-Pacific Exposition.

The special committee of the American materials for road construction and standards for their test and use, is distributing a form of report of data concerning the use of bituminous materials in surfaces Society of Civil Engineers on bituminous and pavements to engineers having charge of bituminous road surfaces and bituminous pavements, asking for the following items of general information: State, county, town or city, highway, contractor, length of work, width of metal (average), date of beginning, date of completion (of use of bituminous materials), method of construction (state character of foundation, thickness of courses, kinds and quantities of road metal and of bituminous materials used, methods used, and approximate maximum grades). (Attach copy of specifications if available.) The committee would like to have responses from all engineers having such work in charge, whether they receive the blanks directly or not.

The official call for the fourth American Road Congress to be held at Atlanta, Ga., Nov. 9 to 14, has been issued by the American Highway Association and forty-eight other good roads associations and other organizations interested in good roads. A preliminary program is also issued, which can be obtained of I. S. Pennypacker, executive secretary, Colorado building, Washington, D. C., or of the local executive committee at Atlanta, Ga. The government exhibit will be a feature and will include a remarkable series of models showing every type of road construction from the military roads of Imperial Rome down to the most modern types of market road and city boulevard. Reproductions of the roads built by the French Bourbons, by Napoleon, as well as the early specimens of macadam road built by John L. Macadam, will make the series historically complete. This exhibit, which is now being prepared by the U. S. Office of Public Roads, will also include a dynamometer equipment, by means of which the exact pull required on every type of road service can be shown with mathematical accuracy.

The Society for Electrical Development, of which J. M. Wakeman is general manager, has on its board of directors members representing central stations, manufacturers, jobbers and contractors, four of each, with four representatives at large. Members of the first two classes pay dues equal to one-fifteenth of one per cent. of annual business and of the last two, one-twentieth. The society has a number of experts in the field who work upon the development of the uses of electricity, aiding local members when desired. New business getting, better specifications, motor drives of machine tools, household uses of electricity in heating, cooking and running various apparatus, including refrigeration and ventilation, devices for advertising in all lines and by all methods, window display light-

ing, store lighting, are a few of the lines in which these men are employed.

The Panama-Pacific International Exposition has issued a handsomely illustrated booklet of the exposition in color, well worth asking for. The Engineering Congress will be held Sept. 20 to 25, 1915.

The eighteenth annual convention of the Central States Water Works Association was held at Wheeling, W. Va., Aug. 25, 26 and 27, 1914, with an interesting program. R. P. Bricker, secretary, Shelby, Ohio.

Technical Schools

The latest addition to the curriculum at the Massachusetts Institute of Technology is the establishment of courses in highway engineering in the Department of Civil and Sanitary Engineering, under the general supervision of Professor Charles M. Spofford, head of the department, the instruction in highway engineering being given by Professor Hector J. Hughes, who comes from Harvard.

Personal Notes

The H. B. Pullar Co., of Detroit, Mich., have been retained by the Michigan State Highway Department to supervise the construction of an open-specification type of asphaltic concrete pavement on an extension of the Wayne county concrete road on Woodward avenue, Detroit. This road was improved with bituminous macadam, penetration method, and did not resist the traffic on the road successfully.

E. St. Elmo Lewis is vice-president and general manager of the Art Metal Construction Co., Jamestown, N. Y., from Sept. 1.

Alexander Potter, consulting engineer, New York City, has been retained by the government of Cuba to investigate on behalf of the Secretary of Public Works, the completed construction on the sewerage system now in progress and to pass upon a project for the enlargement of the water supply of Havana.

Wilbur Allan Ginn, formerly of Columbus, O., in his work as engineer of street and highway improvements in Florida, has adopted ,what he calls auto corners, being circular curb corners with 25-foot radius, about which he claims an automobile can turn at twenty miles an hour. He has promised some photographs of streets so built and some data on building pavements on the sand base universal in Florida, as the vibration, variations of grade of brick paved streets and their cause and method of prevention, in the state which is not troubled with freezing of the soil.

C. M. Foster, formerly secretary of Meacham and Wright Company, Chicago, dealers in building materials, is appointed district manager for the Edison Portland Cement Company at Philadelphia, vice J. T. Wakeman, transferred to New York.

Roger L. Morrison, highway engineer with the United Gas Improvement Company of Philadelphia., M. A., Columbia University graduate course in Highway engineering, has been appointed professor of highway engineering in the Agricultural and Mechanical College of Texas.

Civil Service Examinations

The U. S. Civil Service will hold examinations at the usual places as follows:

September 8: Expert Radio Aid at Naval Radio Station, Radio, Va., at $10 a day; and September 16 for same at $6 a day at New York navy yard; and $8 or $6 a day at navy yards at Boston, Philadelphia, Norfolk, Charleston, and Puget Sound.

Publications Received

Effective Voting, an article on preferential voting and proportional representation by C. G. Hoag, general secretary of the American Proportional Representation League, has been published as Document No. 359 of the U. S. Senate, second session of Sixty-third congress. The league has issued its pamphlet No. 5 giving testimony from abroad.

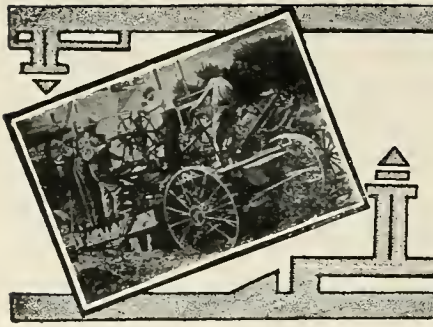
An addendum, being a reprint of the five chapters on Modern Road Construction in Boorman's "Asphalts," 1914 road edition ($2), is published in paper by The William T. Comstock Co., New York, for 25 cents. These chapters are additions to former editions of Mr. Boorman's book.

Bulletins 4, 5 and 6 of the Illinois Coal Mining Investigations describe and illustrate coal mining practice in Districts VII, I and V of that state. They are by S. O. Andros and are published by the University of Illinois, Urbana, Ill.

"The Evolution of Bitulithic and Warrenite for Street and Road Surfaces," a paper presented to the Washington Good Roads Association at North Yakima, Wash., by Walter B. Warren, M. E., Vice President of Warren Brothers Company, Boston, Mass.

Water-Supply Paper 345-E of the U. S. Geological Survey gives a method of determining the daily discharge of rivers of variable slope, by M. R. and W. E. Hall and C. H. Pierce.

James R. Marker, State Highway Commissioner, is editor and publisher of the "Ohio State Highway Department Monthly," begun in February, 1914, and distributed thru the state without cost by the educational bureau of the department in Columbus.



MACHINERY AND SUPPLIES

Water Meter Simplicity

The simplicity of the disk meter, the strength of a special annealed malleable iron or the special hard tough bronze casing, the protection from corrosion by dipping casing in a hot galvanized solution, the protection from frost by the use of a soft gray galvanized cast iron bottom which breaks at 600 pounds, are the principal talking points of the Badger water meter.

The last point mentioned is termed the "big idea" and the breakage of the small and very inexpensive cast-iron bottom saves the delicate and more expensive mechanism of the meter itself from injury by the expansion of the ice when the meter is so set that it freezes in cold weather. The bottom can be replaced for a few cents and is conveniently done by four toggle bolts. The remainder of the meter case and the meter mechanism will continue to operate properly without adjustment.

Thru the removal of the bottom by loosening the toggle bolts it is easy to get at the interior to replace the disk when worn out or to examine, clean or repair the operating mechanism. A light rap on inlet or outlet end of the housing releases the complete working parts for inspection. As 90 per cent. of the troubles with disk meters are found in the disk or measuring chamber this ease of removal is invaluable, especially since the repairs can be made on the spot, thus obviating the delay and expense of taking the meter to the shop and dismantling it.

The interior parts are of phosphor bronze. The housing is so constructed that the current of water completely fills the receptacle both above and below the measuring mechanism, thus keeping the chamber flushed and free of the sediment which deposits in blind pockets or partly filled spaces.

This description applies to the smaller sizes, 1-inch or less. The larger sizes have heavy cast-iron casings thoroly dipped in a non-corrosive coating compound.

That the meter has justified the claims made for it is evidenced by the fact that so many cities are using them in large quantities. Kansas City, Mo., installed 500 Badger meters in 1910, 2,000 in 1913, 2,500 in 1914. Milwaukee has installed 85 to 90 per cent. of its new meters with the Badger. Lorain, O., after installing 500 in 1912 has bought 50 at a time without advertising and uses no others. Manitou, Mich., Mason City, Ia., Scottsville, Mich., Oregon, Ill., use no others, the latter city having 900. Chicago bought 1,000 of ⅝ to 2-inch sizes in 1913. A part of the recent large purchase of meters by Portland, Ore., was of the Badger kind. North and west are well covered with Badger meters, indicating their special popularity in climates subject to very cold weather, where it is sometimes styled the meter minus the troubles.

The Badger Meter Manufacturing Co., 261 Third street, Milwaukee, Wis., are the makers and will supply full information and prices.

Goodyear Tires at Ante-Bellum Prices

The Goodyear Tire & Rubber Co. announce "No war prices on Goodyear Tires." Mr. F. A. Sieberling, president of the company, thus explains their unique position.

"We advanced Goodyear prices, as others did theirs, when the rubber panic came. Almost in a day crude rubber rose in New York from 55 cents per pound to much over a dollar. And, as most of the world's rubber comes via London or Antwerp, we saw no way out for a time.

"The New York supply was too small to consider. European exchange was entirely suspended. Merchant ships had ceased running.

"But we have an almost world-wide organization, and we brought it at once into play. We are the world's largest buyers of high-grade rubber, so we have our own experts in London, Colombo, Singapore and Para.

"We cabled our London people to buy up the pick of the rubber there. By acting quickly and paying cash they obtained 1,500,000 pounds of the finest rubber there. They bought before the advance—before the other buyers saw a way to get London exchange or to bring the rubber here.

"That big supply of rubber is now nearly all on the way to the Goodyear factory in Akron. It constitutes the best of the London supply. On the inferior grades remaining, prices have since been rapidly advanced.

"We have since taken other steps to insure us a continuous supply, all of the highest grade rubber. In all the chief sources of rubber supply we have experts on the ground. All is being done that can be done to secure the best rubber, the exchange to pay for it and the ships to bring it here.

"The result is that Goodyear tire prices are now the same as in June. We are using the same grade of rubber and the same amount of it as we always have used in these tires.

"We are running our factory with three shifts of men, twenty-four hours a day. So long as we remain in this fortunate position on rubber, we shall supply tire users at before-war prices to the limit of our capacity."

Using the Motor Truck

This interesting illustration brings out some of the possibilities of the motor truck. The Bridgeport Hydraulic Company in building a 4,500,000,000-gallon reservoir at Bridgeport, Conn., faced the job of moving a contractor's locomotive to the scene of the construction work. The picture shows how it was done.

This construction company owns four of these trucks and each one of them has been called on frequently for novel service. The locomotive in the above picture weighs 15 tons. The wagon on which it rests weighs 3 tons, and the truck itself is loaded with 5 tons of rock to give it traction. The locomotive was too big and heavy to put directly on the truck body, so this massive wagon was called into service.

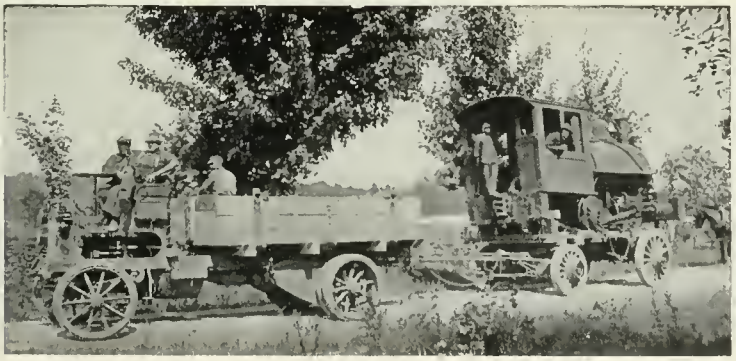
After delivering the locomotive, these trucks hauled all the cement, machinery and supplies for the construction of this reservoir, besides carting 5 miles of 48-inch iron pipe, every section of which weighed 5 tons. No small credit for this performance is due Goodrich Wireless Truck Tires. These trucks effected a 40 per cent. reduction in costs compared with horse-traction haulage.

Metallic Tape Threader

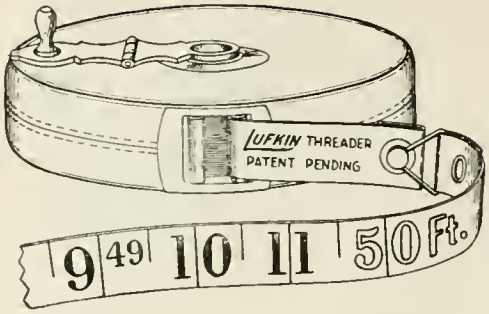
The Lufkin Rule Company (factories at Saginaw, Mich.) have just put out a patented measuring tape attachment, known as a "threader," which will hereafter be furnished with their metallic woven tapes without extra charge.

The threader is a loop and stud arrangement, by means of which the tape, tho securely fastened to the winding drum of the case when in use, can yet be readily detached from it and a new tape as readily attached, no manipulation of the case, case screw or drum being required to do this.

Woven tapes are sometimes torn by accident, or thru long use become soiled and worn in such a way that they must be replaced while the case is yet in very fair condition. The case not receiving the same hard use as the tape line, outwears it, and representing approximately half the value of the outfit, it is of considerable importance that it be a simple matter for anyone to insert a new tape in the old case as often as necessary and thus get the fullest measure of use out



CONTRACTORS LOCOMOTIVE *hauled by motor truck from railroad to location of construction work.*



of the case as well as the tape. Metallic tapes without cases are quite generally stocked by hardware houses, etc., and can always be easily obtained. The attaching is perfectly and easily accomplished by means of the threader.

The Toledo Water Works Have A New Large Pumping Engine

A new high-power water pump, with a capacity of 30,000,000 gallons a day, built by the Allis-Chalmers Co., was recently installed under the supervision of Mr. Wayne W. Mackey, erecting engineer of the company, at the Broadway pumping station of the water works of Toledo, O. It has the distinction of being one of the greatest pumping engines of its class ever constructed, and cost $83,000.

The pump is of vertical triple-expansion design, and the cost of operation is estimated as one-sixth of the cost of maintenance of the original 5,000,000-gallon pumps formerly used. It will increase the water-providing capacity of the Broadway station to 72,000,000 gallons daily. Toledo's normal daily supply is less than half of this amount.

All of the cylinders, heaters and steam lines connected with this giant pump are insulated with J-M coverings furnished by the H. W. Johns-Manville Co. The work was done by the contract department of their Cleveland branch. The cylinders and heaters are covered with 1½-inch J-M 85 per cent. magnesia blocks, finished with ½-inch cement. The high pressure cylinders are insulated with 2-inch magnesia blocks and ½-inch cement. All steam lines are protected with J-M 85 per cent. magnesia pipe covering.

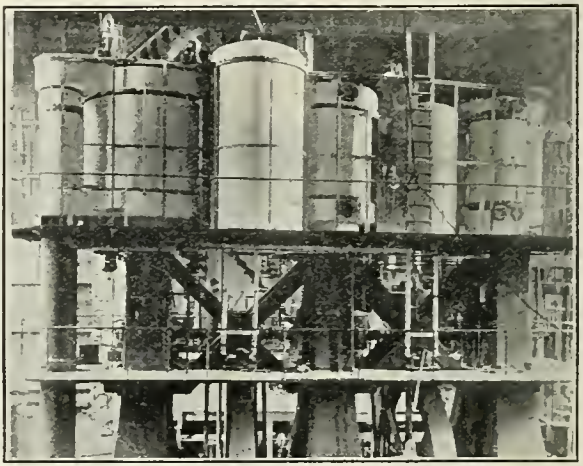
The Toledo authorities expressed themselves as well pleased with both the work of the big pump and the appearance and character of the insulation.

Street Railway Repair Automobile Truck

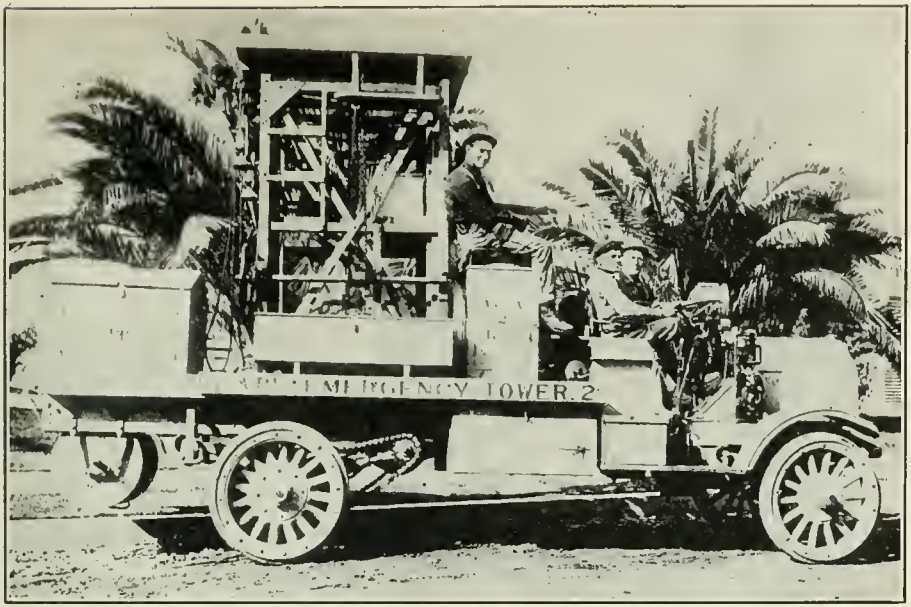
The Kissel tower truck has given the best service of any of the machines used for trolley repair work by the Los Angeles Railway. If a truck is not built right the swaying of the tower and constant running of the engine will rack it all to pieces. The Kissel has been in service about three years. The present daily mileage varies between 8 and 38, with an average around 24. The total mileage since purchase is over 16,000, and the engine has run the estimated equivalent of three times this. Sometimes the engine runs 20 hours out of the 24.

The car is taken out in regular day service at 7 a. m. and the engine runs until 12, then off until 1 p. m. and running from then to 5:30. The crew telephones to a dispatcher on completion of each job and gets instructions for the next. The engine has to be kept running so the truck can be moved off the track to let a trolley car thru whenever required.

The car is used by the night crew for emergency calls, and when there are many of these succeeding the day use, the engine gets a long and severe try-out but has never "boiled." The record of repairs shows that the hard service has worn out one bidy and tower, which have been replaced. The engine has been overhauled in the railway company's shop and a new set of timing gears, new set of push rod guides, and new differential gear provided after about 13,000 miles



NEW THIRTY MILLION GALLON *pumping engine of the water works of Toledo, O.*



of service. These repairs were due to natural wear, and not to any defect in material or design.

The car has had a good many drivers and of all kinds. The attempt is made to prevent overspeeding, and the car is now equipped with a Jones recording speedometer which makes possible a definite supervision. Ordinary running is at 12 to 15 miles per hour and if speed exceeds 18 miles an explanation must appear on the report. If the driver has no emergency to justify overrunning he is hauled over the coals severely.

The trucks of other high grade makes have not stood up as well as the Kissel. One having a three-point suspension shook out many rivets, and required frequent repairs to the engine. All bearings had to be replaced, and the three point suspension taken out and a solid subframe installed. The Kissel has never had to have any bearings replaced. This is an important comparative demonstration of Kissel reliability.

Upkeep cost on the Kissel, which is now in first class serviceable condition, has been about one-third that of another truck in similar service.

How to Make A New Lawn

Prepare the ground as soon as the weather permits and sow the seed (the Velvet lawn broadcast sower is recommended) in March or April, or, should it be a severe season, sow during the early days of May.

It is always good policy to allow as much time as possible in which to prepare the ground. A month or six weeks is not too much, as the surface will, to a certain extent, find its own level, which can more easily be corrected at the time the seed is sown, that is, if the "Velvet-lawn" broadcast sower is used, for the cultivator attachment on the rear of the machine was constructed for this purpose.

When the work is done in a hurry it is generally badly done, as it gives no chance for the surface to consolidate, which is so essential for the welfare of the young grass plants, or for quick-growing weeds to assert themselves and be destroyed before the grass seeds are sown.

The making of a new lawn can roughly be divided into five operations, viz: Dig-

HAND POWER SEEDER *for use on putting greens and small city lawns.*

HORSE-DRAWN SEEDER *for use on large lawns and grass areas.*

ging, manuring, preparing the seed bed, seeding and after treatment.

Dig to the depth of a spade, turn the soil well over, break up the large clods, pick out all large stones, roots, etc. Grass being a shallow-rooted plant makes it quite unnecessary to work the soil to a greater depth, unless the old turf is to be buried, then the surface should be turned over to a depth of two spades.

In most cases the results will be better and quicker if the soil is manured.

The best general manures for digging in are fresh peat moss, stable manure, and old well-rotted short straw. These manures should be spread over the surface at the rate of one load per 100 square yards, and forked or dug into the soil in such a way that the bulk of it remains within 2 or 3 inches of the surface. Some people maintain that manure, if used, should be buried at least 6 inches deep, while others hold that it should not be used at all, otherwise the grass will grow coarse and rank.

It has been proved over and over again that the closer the manure is kept to the surface the better and quicker are the results, because the young grass can reach it quickly and receive the desired help where it is most required, that is to say, during the early period of its existence, whereas, if it is buried deeply it will take months for the roots to reach it, and it is quite possible, and it often happens, especially during unfavorable seasons when grass grows very slowly, for it to perish for want of manure, in spite of the fact that plenty has been put in the ground, but out of reach.

The suggestion that manure makes grass grow coarse and rank is another fallacy; if a mixture of coarse grasses is sown a coarse turf will be produced, but if a mixture of the finest grasses is sown a turf of the finest quality will be produced.

Prepare the seed bed by breaking up the clods, removing large stones, and all weed roots with the cultivator attachment on the sower; then roll the ground with a "Velvetlawn" roller until the surface becomes quite firm, true and fine, and, when walked on, hardy shows the imprint of the foot.

Seeding is the most important operation in the making of a new lawn or green, because, no matter how good the soil or seed may be, the results will be both better and quicker if the seed is deposited into the ground.

The "Velvetlawn" seeder or sower makes it possible to sow any time—wind

or no wind. Put your seed in the ground when the conditions are right. Heavy rains cannot wash the seed away, neither can birds eat it. The seed is deposited into the soil to a depth not exceeding one-fourth of an inch. The ground should again be rolled and cross-rolled with the "Water-Weight" roller.

The young grass should appear above the ground in about 14 to 21 days if spring sown, according to the weather. When about 1 inch high it is greatly benefited by an application of prepared compost or fertilizer. These top dressing materials are very gentle in action, they do not burn the young grass, but they protect it from extremes of temperature and assist to conserve moisture.

When the young grass is about 1½ inches high it should be rolled with a "Water-Weight" roller, and when about 2 inches high it is ready to be cut. It is most important to regularly mow and roll the young grass from the very start, otherwise it will grow long and thin, instead of branching or "stooling" out and covering the ground.

The seeders and rollers are made by the Velvetlawn Seeder Company, Springfield, Ohio.

Parcel Post Carried on Diamond Tires.

Uncle Sam's parcel post automobiles all over the country now are running on Diamond tires, which won the government's award recently.

The expansion of the parcel post field to include heavier shipments than were originally planned brought the post office department face to face with the problem of automobile transportation. In many cases good sized trucks are used to handle the great variety of goods which the new post office system carries.

Diamond tires were chosen on the basis of quality and price. The Diamond ability to do hard work with least wear, coupled with the Diamond prices, brought the award.

Kissel Trucks in Los Angeles Water Department

Two 1,500-lb. Kissel trucks have been in use since some time in 1912 for meter service of the Los Angeles Water Department. These cars are worked daily with a crew of two men changing meters, etc. Loads are light in proportion to the capacity of the trucks, the requirements of the service limiting them to not over 600 lbs. The service rendered is high in point of mileage when the number of stops per day is taken into consideration. Seldom does the number of separate jobs which the use of this car enables its crew to handle fall below forty. The number is usually much higher, frequently running close to 100, and the crew boasts of one day when they gave decisive proof of their own efficiency and that of their truck by clearing up 125 jobs. As the truck is standing while work is being done, and mileage per day averages about 40, it is apparent that between jobs high speed running is indulged in to an extent rather unusual in commercial vehicle operation. This is admitted by officials of the department.

A 2-ton Kissel is used in connection with installation of big meters and services. It is usually loaded close to capacity, and carries a crew of four men. As not more than a dozen jobs, and sometimes only one of this type can be handled in a day, the car has much standing time.

All repairs necessary are made in the department's shop. The cars have required very slight attention, and are considered to be in as good serviceable condition as when new.

The department also operates three Kissels of the pleasure car type.

The city of Riverside is using Kissel trucks in water department service.

Trade Publications

The C.-A.-Wood-Preserver Co., St. Louis, Mo., is distributing a broadside "warning to the users of wood preservers," accompanied by a diagram showing comparative evaporation of coal-tar creosote and C. A. wood preserver.

A "Statement to the Common People" about septic tank satisfaction is made by the Ashley House-Sewage Disposal Co., Morgan Park, Chicago, Ill.

The Milwaukee Conduit and Insulation Co., Milwaukee, Wis., issues a booklet descriptive of a patented "Portland sectional conduit" of vitrified glazed tile.

"Iron Roofs That Resist Rust," "A Journey to Armco Farm," and "Defeating Rust" are three recent pamphlets of the American Rolling Mill Co., Middletown, O., detailing the uses of American ingot iron.

The Keystone and Eureka water meters are fully described and illustrated in a new booklet issued by the Pittsburg Meter Co., East Pittsburg, Pa.

A Second Plea for Publicity in the office of County Treasurer of Cook County, Ill., is made in a 12-page pamphlet by the Chicago Bureau of Public Efficiency.

Proceedings of the Twentieth annual convention of the American Society of Municipal Improvements, held at Wilmington, Del., Oct. 7-10, 1913. Charles Carroll Brown, secretary, 702 Wulsin Bldg., Indianapolis, Ind.

CONTRACTING NEWS

AUTOMOBILES—FIRE APPARATUS.

BIDS REQUESTED.

Cincinnati, Ohio—September 1, until noon, bids will be received for one 4-cylinder 5-passenger touring car of 30 to 35 h.p. Ernst Von Bargen, city purchasing agent.

Eremont, Neb.—September 14, until 8 p. m., bids will be received for one automobile combination fire truck, equipped with chemical tanks, extension ladders, roof ladders, lanterns, searchlights, headlights and all other necessary equipments. Certified check, $200. John Gumb, chairman Board of Public Works.

St. Bernard, Ohio—September 5, until noon, for 1,000 feet double packet standard or two-ply multiple 2½-inch fire hose. Address director of public safety.

CONTEMPLATED WORK.

Delphos, Ohio—Purchase of auto fire truck being considered. Mr. Westrich, fire chief.

Hamtramck, Mich.—Bond of issue of $58,000 voted for fire department equipment and buildings. Motor-driven apparatus will be installed, consisting of one engine, one combinational chemical and hose cart and ladder truck. John C. Schultheis, village clerk.

Jersey City, N. J.—Purchase of following equipment being considered: Two motor-driven pumping engines, cost $20,000; two motor tractors for fire engines, cost $8,500; two aerial trucks, cost $22,000, and installation of fire alarm boxes, to cost $2,500. Frank Hague, director of public safety.

Lorain, Ohio—Bids for motor aerial fire truck rejected and new proposals called for. Appropriation $10,000. J. J. Pollock, mayor.

Portland, Ore.—Bids will be asked shortly for 13,650 feet fire hose. Mr. Albee, mayor.

San Marcos, Tex.—Bond issue of $20,000 voted for fire department equipment.

FOREIGN TRADE OPPORTUNITIES.

No. 13517—Automobile Supplies—Local importer desires to act either as agent on commission basis, or represent in certain territory American manufacturers of automobile supplies.

No. 13556—Cycle Car—South African business man desires to secure agency rights for an American cycle car suitable for that country. Car must be right-hand drive, good clearance and moderate in price.

No. 13558—Motor Car and Motorcycle Accessories—South African firm desires catalogs, price lists of motor cars, motorcycles and cycles. Address may be obtained from Bureau of Foreign and Domestic Commerce, Washington, D. C.

Addresses omitted may be obtained from Bureau of Foreign and Domestic Commerce at Washington, D. C.

BRIDGES.

BIDS REQUESTED.

Anderson, Ind.—September 11, until 10 a. m., bids will be received for following bridge work: Single span, 140 feet long, over White River at Twelfth street, this city; creosote block floor and painting bridge over Mud Creek, West Washington street, Alexandria, Ind.; creosote block floor, painting and other repairs on bridge over Pike Creek, South Harrison street, Alexandria; creosote block floor, painting and other repairs on bridge over Pike Creek, Park avenue, Alexandria. Joel B. Benefiel, auditor Madison County.

Baltimore, Md.—September 15, until noon, for bascule span, section 4, of Hanover street bridge. Certified check, $2,500. Wm. L. Marcy, secretary State Roads Commission, 601 Garrett Building.

Canton, Ohio—September 9, until 10 a. m., for bridge at Massillon, to include 600 cubic yards excavation and 1,520 cubic yards concrete, 182,000 pounds reinforcing bars and 523,000 pounds steel work. C. L. Stoner, county clerk.

Carroll, Iowa—September 7, until 2 p. m., for eleven concrete culverts and one steel bridge in Carroll County. Estimated cost of culverts, $9,341; of steel bridge, $4,000. Henry M. Hanssen, county engineer.

Delaware, Ohio—September 10, until noon, for superstructure of Beiber bridge, Liberty Township, consisting of two 82 feet 4½ inches c. to c., pin-connected low truss spans and three plate girder spans 60 feet each, with 16-foot roadway. Certified check, $200. W. V. Aldrich, auditor Delaware County.

Elberton, Ga.—September 28, until noon, for county line steel bridge over Broad River above Moore's Ferry, near Bowman, Ga., consisting of one span 160 feet, one span 120 feet and three spans of 80 feet each. Certified check, $200. James McIntosh, chairman Commissioners Roads and Revenues of Elbert County.

Escanaba, Mich.—September 21, until 10 a. m., for one 343-foot 6-inch I-beam bridge with 16-foot roadway over Escanaba River. Certified check, 5 per cent. of bid. R. P. Mason, Delta County.

Newcastle, N. Y.—September 8, until noon, for concrete and masonry arch bridge at Mill street, Mt. Kisco village. Certified check, 5 per cent. of bid. Nelson Sarles, town superintendent of highways, Newcastle.

Overton, Neb.—Until September 11, for Overton bridge; estimated cost, $45,000. Alternate designs as follows: Concrete girder bridge of 25 to 36-foot spans, 16-foot roadway, with concrete piers and abutments, paving over roadway, and protection work; concrete arch bridge of 16 to 50-foot spans with concrete piers and abutments, 16-foot roadway with earth fill over roadway and protection work. Address county clerk, Lexington, Neb.

Petersburg, Ind.—September 8, until 2 p. m., for two steel bridges in Jefferson Township, two steel bridges in Marion Township, four steel bridges with concrete abutments in Lockhart Township, one steel bridge with concrete abutments in Logan Township, one removal of bridge in Lockhart Township and four steel bridges with concrete abutments in Monroe Township. John D. Gray, auditor Pike County.

Salem, Ind.—September 12, until 1:30 p. m., for four concrete bridges in Washington County. F. S. Munkolt, auditor.

San Diego, Cal.—September 10, until 2 p. m., for reinforced concrete girder bridge of 19-foot 11-inch span across El Horne Creek. Certified check, 5 per cent of bid. Clerk, San Diego County.

CONTRACTS AWARDED.

Baltimore, Md.—To H. P. Converse & Co., Boston, Mass., main structure of Hanover street bridge at $607,897.55.

Charlotte, N. C.—To Virginia Bridge & Iron Co., Roanoke, Va., bridge across Catawba River at Mt. Holly, at $18,172.

Dallas, Tex.—To Hess & Skinner, Dallas, three bridges over Elm Creek fork of Trinity River, at $27,250.

Elmira, N. Y.—To Nicholson, Avery & Andrews, city, repairing of stringers on Madison avenue bridge, at $3.98 a stringer.

MUNICIPAL ENGINEERING

The World's Leading Municipal Publication.

PERFECT CONCRETE PAVEMENTS OFFER IDEAL CONDITIONS FOR MOTORING.

VOL. XLVII. OCTOBER, 1914. NO. 4.

Living has come to depend largely on engineering, which might be broadly defined as the application of intelligence to the work of mankind. Its problems are never solved by militant methods, but by thought and experiment. War is carried on largely with the aid of engineers and engineering knowledge and apparatus. The engineering profession is therefore deeply concerned in it. To the medical profession war is an opportunity, to the engineering profession a disgrace. It will not long consent to be ruled by militant racial egotism.

JOHN NORMALAND.

Published by

Engineering Publishing Co.
INDIANAPOLIS, IND.

New York Office:
1127 World Bldg.
GEO. H. CLINGAN,
Eastern Mgr.

Chicago Office:
1634 Marquette Bldg.
E. D. POWELL,
Western Mgr.

Entered at Postoffice, Indianapolis, as Second-Class Matter.

A. P. Fox, President. **C. C. Brown, Editor.** **C. S. Sale, Gen'l Mgr.**

Subscription Price in U. S. and Possessions, Cuba and Mexico, $2.00. Canada, $2.40. Foreign, $2.75.

Changes of address, subscriptions, remittances and editorial matter should be addressed to MUNICIPAL ENGINEERING, Indianapolis, Ind.

TANK CAR HEATED BY STEAM FROM BOILER AND UNLOADED BY STEAM PUMP TAKING THE TAR THRU DOME OF TANK CAR FOR MASSACHUSETTS HIGHWAY COMMISSION AT PONDVILLE.

METHODS *of* UNLOADING TANK CARS

By Philip P. Sharples.

The author of this practical paper speaks from his daily experience in solving engineering problems of the Barrett Manufacturing Company, and he can therefore give a broad view of the subject and many suggestions of details which can be utilized by others in designing their plants of the same nature.

TANK cars are now almost universally used for the delivery of bituminous road materials wherever the size of the job and the nature of the bituminous material admit of bulk shipments. The economy and dispatch of tank methods make them preferred wherever possible.

The use of bituminous materials, both as dust layers and as binders, has become so common, especially in the large cities, that many municipalities have fitted up plants especially for handling and storing oils, asphalts and refined tars. Such a plant consists of storage tanks and heating boilers, conveniently arranged beside a railroad siding.

Storage tanks should be provided in numbers sufficient to accommodate the different classes of tars or oils to be used at one time. The tanks should preferably be of 12,000 gallons capacity, to accommodate a full tank car of 10,000 gallons, with a leeway of 2,000 gallons to insure extra capacity enough to prevent demurrage if a new tank car arrives before the previous one is exhausted.

The tanks should be provided with sufficient steam coils to heat a charge from air temperature up to 200 degrees in twelve to fourteen hours. Under ordinary circumstances ten to twelve lengths of 1¼-inch pipe, kept well down on the bottom of the tank, will be sufficient. A 15 to 20-horse-power boiler, carrying 80 pounds of steam, will be necessary. To effect economy of heat it is desirable to lag the tanks.

If pumps are required, the boiler will also provide steam for the pumps. Steam

STORAGE TANK *in city yards at Springfield, Mass. Tar or oil flows by gravity from tank car to storage tanks. Auto truck or tank wagon is filled by gravity from storage tank.*

pumps with large clearances and metal valves should be chosen. Rubber valves would soon rot out.

The city of Springfield, Mass., has a well-arranged plant of this character. Two storage tanks are provided, mounted on concrete stirrups high enough to allow a tank wagon or auto truck tank to back under the loading spout and load by gravity. Fortunately, the railroad at this point is sufficiently elevated to allow the bituminous material to flow also by gravity into the storage tank, thus dispensing with pumps altogether.

Instead, however, of a well-arranged stationary plant, the engineer is usually confronted with the problem of heating and distributing the bituminous material from some inconveniently located siding.

If possible, a raised siding or trestle should be sought, of sufficient clearance to allow a tank wagon to be filled by gravity. By digging a pit for the tank wagon to back into, sufficient head may often be obtained where otherwise impossible. A pipe is then used to convey the tar or oil to the tank wagon or a trough is built of wood and lined with tin or heavy building paper. With the binders and hot-surfacing materials a heating plant is necessary of 15 to 20-horse-power, giving 80 pounds pressure. Tank cars for shipping bituminous materials which require heating should be equipped with steam coils capable of heating the contents up to 200 degrees Fahrenheit in twelve to eighteen hours. During the autumn care should be taken to select a site for heating tank cars protected from the cold winds. Neglect of this precaution often leads to difficulty in obtaining material hot enough to work properly.

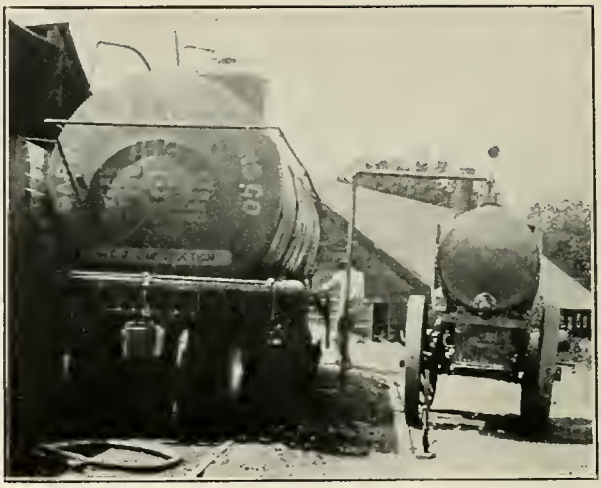
Cars set on level sidings must be pumped out or the contents forced out in some way. Thin oils and tars present no great difficulty. Many forms of pumps will handle them

PLANT FOR HEATING REFINED TAR *at Nashua, N. H. Tank wagon is backed into pit sunk so as to get gravity flow.*

without difficulty, and the pump may be set to take out of the outlet cock on the bottom of the tank car, or the intake pipe may be lowered thru the dome. In selecting a pump, one without rubber packing should be chosen, since both oils and tars destroy rubber very quickly. Metal valves can now be had on hand, steam and rotary pumps suitable for the purpose. A 2½-inch intake and a 2-inch outlet are desirable sizes of piping.

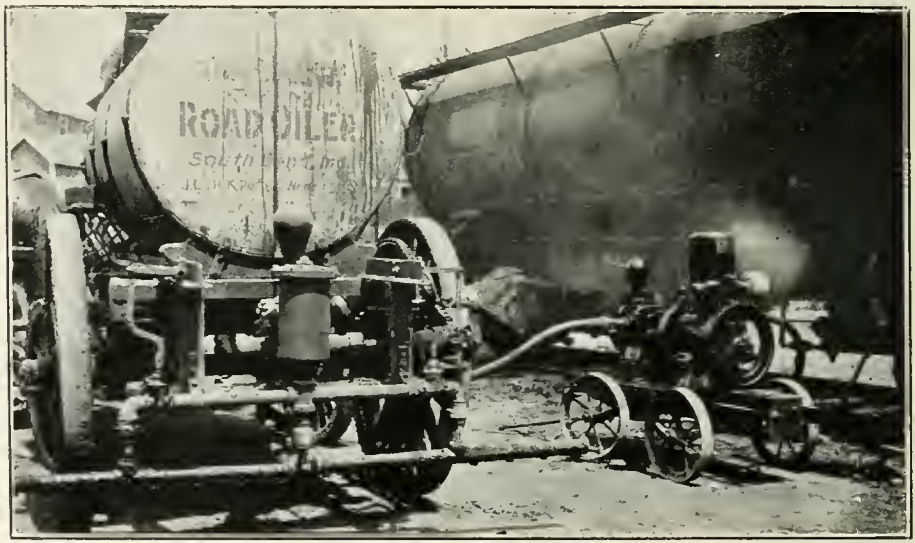
Outfits are also available run by gasoline engines, that are handy and easily portable. They may be had in both reciprocating and rotary pumps. The delivery should be from 40 to 50 gallons per minute.

Asphaltic oils which require slight heating for application and the light refined tars can usually be liquefied sufficiently to work well with the ordinary pumps. They can also be handled with some form of ejector apparatus operated with steam, such as the Kent unloader. Since steam is driven directly into the material, an ejector is not available with the heavier asphalts, which require further heating over a direct fire. The water in this case would cause foaming.



TAR CAR WITH STEAM FITTINGS *to blow refined tar binder from car to tank wagon by steam pressure. Note fittings on top of dome. Steam taken from stationary steam plant on left. Watseka, Illinois.*

GASOLINE-DRIVEN KINNEY ROTARY PUMP *outfit unloading seventy gallons of Tarvia B per minute at Hull, Mass.*

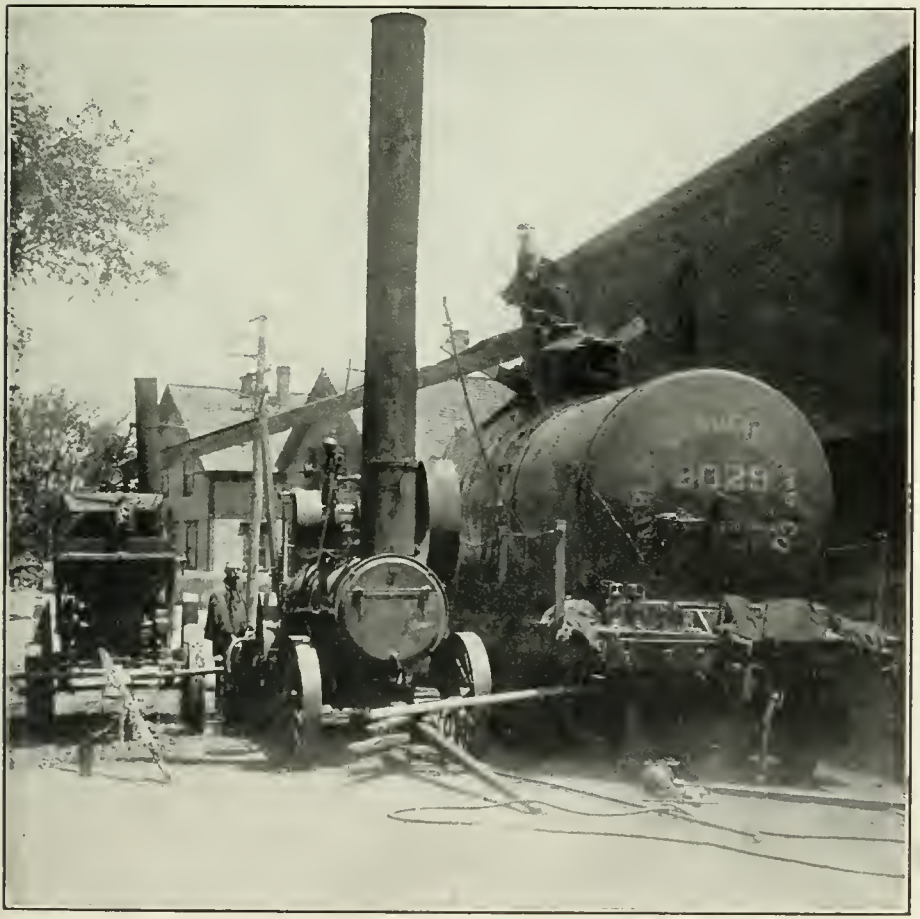


Heavy tars used for binder purposes and heavy asphaltic oils require special precautions in providing means for heating all parts of the unloading pipes and pumps and for blowing them free of binder after a tank wagon is filled. The simplest method is to introduce a live-steam inlet into the unloading pipe directly beneath the shut-off cock on the tank car. The pipe and pump can then be blown free by steam at any time or a cap can be screwed onto the delivery pipe and live steam blown back into the tank car. The small amount of steam used in this way has no deleterious effect on the bituminous material.

Heavy tar binders may also be unloaded by introducing direct steam pressure on top of the tar in the tank car. The small amount of water introduced remains on top of the tar and does no harm. The method is not available with asphalts, since the water introduced produces violent foaming when the asphalt is subsequently heated.

In arranging the piping for blowing, a steam connection is made thru a hole drilled for the purpose thru the cover of the dome of the tank car. A valve and a steam gage are provided to regulate the pressure. No more than 7 or 8 pounds should be used, and this will be ample if the binder is sufficiently liquid. The tank

REFINED TAR BINDER UNLOADED *by Edson diaphragm pump, taking from dome and discharging into lined wooden trough. Lawrence, Mass.*



cars are not designed to carry more than this pressure. This method is very neat and effective with heavy tar binders and requires no expensive apparatus.

TANK CAR SET ON TRESTLE, *with heating boiler on ground below. Refined tar binder flows by gravity into tank wagon. Laconia, N. H.*

PITTSBURGH'S NEW POLICE SCHOOL

By Hartley M. Phelps, Pittsburgh, Pa.

Most of the complaints of poor service by individual policemen and by police systems arise from the control of the system from outside and the lack of experience and adequate instruction of patrolmen. The former demands removal of control from politics and placing of appointments on a merit basis, and both new appointees and those already in the service can have their efficiency increased by means of the instruction herein provided for. Pittsburg is not alone in the establishment of means of instruction, but seems to have a particularly effective plan.

PITTSBURGH has established a training school for its police, opening about October 1, under the direction and tutorship of Capt. John A. Ford, a Pittsburgh police officer, who has seen service in the United States army. There will be about 900 pupils—that is, the total force of policemen in the city. The school will be not only for patrolmen, but for sub-policemen as well, and is to give courses for the ordinary officers, traffic men and the mounted police, all of which are represented on the force. According to the plans this school bids fair to be one of the most complete and thoro in the United States, and will rank with the best schools of a similar kind established in other cities thruout the country.

The decision to found it is the result of the systematic work of the city council to reform and reorganize the police bureau of Pittsburgh. With this end in view, the Emerson Company, of New York City, was engaged to make a thoro investigation of the bureau, and recommend, as experts, what should be done to place it on a strictly modern basis after the most approved pattern. In its report, submitted to council last fall, it charged, among other things, that one of the chief defects was a lack of discipline. Entanglement in politics and protection of offenders against the law were also set forth. Persons with political power were often instrumental in effecting appointments to the police force, it said.

Much of the inefficiency of the bureau, it further stated, was due to the absence of any method of scientifically training the policemen. Another radical defect was the lack of centralization of control in the office of the director of public safety, under whose jurisdiction the bureau falls. It was also pointed out that lack of records as to crime, and number of arrests, and information as to whether the detectives were performing their duties intelligently, made it impossible for the director to maintain adequate control over the bureau. The activities of the detective bureau were severely scored on the ground of inefficiency.

Concluding this phase of its report the Emerson company said: "The success or failure of police management depends almost wholly upon the department head being honestly advised, thru reports, of the bureau's activities."

Among the important things that will be taught in the classes are to impress on the recruits and on those already on the payroll the fact that they are employed and paid by the people of Pittsburgh; and that they are the people's servants. They must never, under any circumstances, be discourteous to any man, woman or child, or to their superiors, or

even to those under arrest or detention. They are to be especially courteous to people who ask for information, because frequently the first impressions strangers get of a city are from the police. Profane language may not be used at any time; but the officer must conduct himself with dignity and try to win the respect of all with whom he comes in contact: and especially the esteem of the people living along his beat.

Instruction is to be given as regards arrests. Force is not to be used to effect an arrest unless there is resistance, and the use of force must cease as soon as the prisoner is overcome. Firearms may be used only in the pursuit of felons; but they must not be used if innocent persons are endangered thereby, or the felon can be captured without their use. Of course an officer may use his firearms in self-defense, or in defense of a prisoner he has in his custody. The same is true of any citizen or brother officer upon whom a dangerous assault has been made in his presence. An officer must not, however, shoot at a person running away and who has only committed a misdemeanor or trivial offense.

Of course, officers must be reasonably familiar with city ordinances that it is their duty to enforce; so it follows that an important part of the course is the study of such ordinances. Court decisions bearing on the same will receive attention.

PAVING AND BRIDGE TOLLS IN BAVARIA

Practically all Bavarian cities collect a paving and bridge toll, and every road leading into almost every city has a tollhouse somewhere near where it crosses the city line, where automobiles, wagons, carriages, saddle horses, etc., and in some instances motorcycles and even bicycles must stop until the amount of toll (fixed by city ordinance for the particular municipality) is paid.

In Nuremberg all pleasure vehicles owned outside the city may pass in and out freely and without toll, but the pleasure vehicles owned at home are required to pay an annual lump toll. All freight vehicles and draft animals owned outside the city must still stop at the tollhouses and pay.

The collections for bridge and paving tolls in Nuremberg for a year amount to about $46,000. The dividing line between heavy and light is 1,500 kilos (3,307 pounds). The trip toll rates are as follows: For every draft animal in heavy vehicle, 40 pfennigs (9.52 cents); for every draft animal in light vehicle, 20 pfennigs (4.76 cents); for every other draft animal, 15 pfennigs (3.57 cents). Freight automobiles and pleasure cars owned in the pity pay the rates for two-horse teams, light or heavy, according to weight.

For the collection of these tolls the municipality maintains a central office in the city and 22 toll stations on roads leading into the city. Toll stations also collect the octroi taxes on beer and malt and issue certificates to parties bringing live stock or meat into the city. These latter certificates must be presented at the municipal slaughterhouse and constitute a check guaranteeing the due inspection of all live stock or meat brought into the city. Several large breweries are located in near-by towns, and the beer tax reaches a considerable total—about $120,000 annually.

Only the collection of the beer and malt octroi makes the maintenance of the Nuremberg tollhouses profitable, for the amount of paving and bridge toll they take in is trifling. In the smaller towns, especially those lying upon main traveled roads, the paving and bridge toll realizes handsome sums for the municipalities, and while the tollhouse is anathema in the eyes of the auto tourist, it nevertheless serves as well the good purpose of preventing reckless and dangerous speeding thru the often crooked and narrow streets of an ancient and picturesque city.

PORTABLE ASPHALT PLANT

RESURFACING MACADAM ROADS IN CHICAGO.

By Walter G. Leininger, Superintendent of Streets.

The author supplements his paper on the asphalt paving plant of Chicago, published last month, by this description of the city's portable plant for surfacing outlying streets requiring protection at reasonable prices from constantly increasing volume and weight of traffic. It can be applied to still less expensive work on main country roads if desired.

THRU the efforts of Mayor Harrison, the Highways Improvement Association and the Association of Commerce co-operating, in 1913 an appropriation for street repair equipment was secured and machinery installed that marked the inauguration of increased efficiency in street repairs chargeable to the wheel tax.

At the close of the year the bureau had complied with the earnest demands of the outlying districts and suburbs by completing a series of connecting links from these localities to the city's paved streets. Previous to this time some of these districts were entirely shut off for a considerable time on account of impassable roads. These roads were naturally constructed of water-bound macadam and oiled.

Naturally, macadam seems to be the answer when the first improvement is considered, and altho very little can be said in favor of it when subjected to heavy traffic, it is the foundation for the future good road. The price is the first consideration, but the maintenance has cut such a noticeable figure that further consideration must be given the subject. When the maintenance runs up to 20 cents per square yard, it is appalling to think that in five years the original cost of the pavement has been duplicated. When ditching, grading, laying and properly constructing the shoulder is completed, a dollar a square yard is cheap, and yet the Bureau

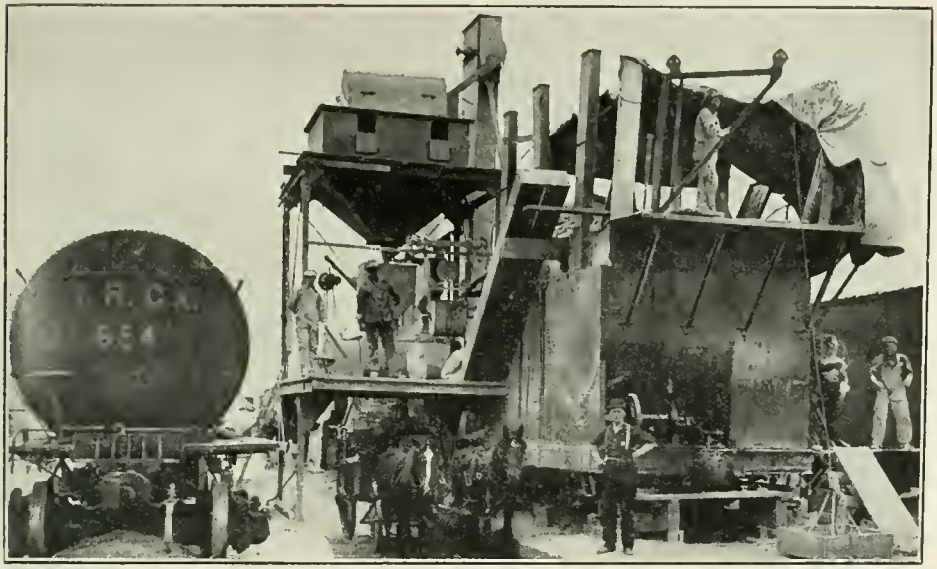
UNLOADING STONE *at the rate of one car an hour for resurfacing roads with macadam before placing two-inch top of asphaltic macadam.*

TWO VIEWS *of Chicago's portable asphalt paving plant. Note portable office at left of lower picture. Note method of unloading stone from cars by means of wheelbarrows on running boards from tops of flat cars to top of pile, seen in lower picture and in part in the upper picture. Photographs taken on the inspection trip referred to.*

of Streets constructed 83,000 square yards at a cost of 56 cents per square yard.

"Why does this pavement fail?" has been asked many times, and the answer has always been low, wet land, and the tendency for traffic to keep in the same rut on an 18-foot road. To eliminate this it was decided to cut down the crown and resurface these roads as fast as possible with a 2-inch top of asphaltic concrete. The present asphalt plant was located to take care of asphalt repairs on the city's streets out of reserve; hence the necessity for a portable plant was imperative. Such an equipment, in the shape of a one-car portable plant, equipped to burn coal or oil, was purchased from Warren Bros. at a cost of $13,000.00. This plant can be moved about at the outskirts of the city, and the resurfacing of old macadam country roads has now begun in earnest. The plant has been turning out 2,500 square yards of 2-inch top per day, or 1,000 linear feet of 18-foot roadway is being done in nine hours. The bureau is completing a mile each week, and the cost per square yard is approximately 70 cents. This includes all cost of preparing the old road and laying the 2-inch top.

Such an improvement will last five years without repair; and the maintenance will then be slight in comparison to the old water-bound macadam. It is desirable to have at least ten inches of stone at the center and from four to six inches at the edges, hence, in some cases three to four inches of new material is laid on the road before resurfacing. The surface is made as flat as possible, and, since Chicago is naturally flat, there are no noticeable grades. The old macadam roads were



ANOTHER VIEW *of the portable asphalt plant, showing mounting on car and the mixing platform in place for operation; also unloading of materials from tank and box cars on either side and the crane elevator for raising materials to top of plant.*

constructed with as little grading to profile as could be accomplished, hence the finished resurfacing is practically at the same profile. An absolute profile would necessarily be followed in a rough and uneven locality, which would increase the cost considerably.

When it is considered that the department has repaired 300 miles of macadam pavement this year and resurfaced five miles of it with asphaltic concrete, the great amount of work ahead seems appalling. The success of this improvement is hinged entirely upon the wheel-tax collections, which up to date represent $650,000.00. Out of this the department has spent for all repairs $450,000.00.

The present plant can resurface thirty miles in a season without trouble, and, with the proper funds and equipment the 500 miles of macadam streets in Chicago would soon be made permanent pavements. An earnest endeavor along this line should be followed, for then the cost per linear foot to the property would not exceed $1.25 on each side of the street. When this price is compared with the assessment usual for a permanent pavement the resurfacing plan should be met with approval by the property owners and parties interested in good roads.

Every interest is directed to the proper and scientific methods of doing this work and in obtaining the best results.

The mix so far will average approximately 6.5 per cent. bitumen, 37.2 per cent. sand, 52.3 per cent. stone and 4 per cent. filler. The aggregate being used is crushed granite ranging from ¼-inch to 1-inch in diameter, with torpedo sand and Universal Portland cement. The price of granite this year is $2.25 per cubic yard.

The plant is located on a center track, with two switch tracks, one on each side thereof, and 16 feet distant. Material is placed on these tracks and unloaded directly in front of the different conveyors. The sand and stone are mixed in proper proportions and run into the dryer, where the mixture is heated to 300 degrees F. From there it is conveyed to the storage bins and thence to the measuring bins, where it is drawn off to the 15-cubic-feet mixer as required.

To facilitate the quick delivery of material on track, the bureau has a car tracer, who covers the territory on a

motorcycle and keeps the cars in transit. This man covers a distance of 75 miles each day.

The work of preparing the old macadam road differs somewhat in different localities. Where the existing surface is in good condition and has a suitable line grade and contour, the surface is swept thoroly to remove all the loose particles and expose the rough stone. If any depressions exist they are filled with binder and tamped. In this way the existing road is made parallel to and two inches below the finished surface. Along the edges of the road care is taken to provide a good shoulder to hold the pavement in place. Where the soil is soft, stone is added and the shoulder thoroly rolled.

Where the old macadam is flat or depressed at the center, the sides are picked up and the material moved to the center. Care is taken not to lower the sides so that less than four inches of stone exists in a firm condition.

Where the condition is such that additional material is required, the street is scarified to a depth of three inches and material added, making the center at least ten inches in depth and the sides six inches. About 2½ inches is found sufficient for drainage from the crown to the edge. At the present time the plant is running at capacity, and the force at the plant and on the street consists of:

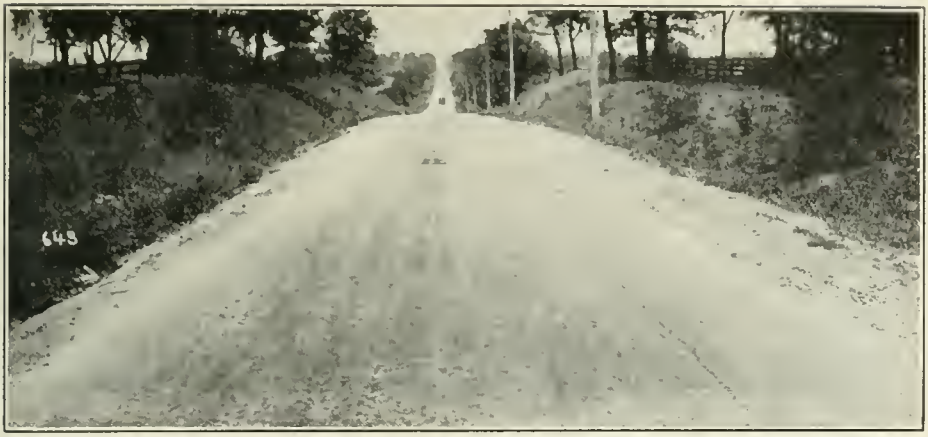
Plant—1 foreman asphalt plant, 1 chief drum man, 1 drum man, 1 kettle man, 1 mixer man, 2 time keepers and material men, 25 laborers, 18 teams, 1 assistant chemist and 2 watchmen.

Field—1 asphalt foreman, 2 rakers, 2 smoothers, 2 tampers, 15 helpers, 2 watchmen and 2 roller engineers.

In order to hold the present macadam streets in place until they can be resurfaced at some future time, the bureau has used 1,720,000 gallons of heavy road oil. This oil helps to bind the macadam and stops the dust nuisance. Road oil was purchased this year for approximately 3.64 cents per gallon.

On July 30, the Bureau of Streets, in conjunction with the Association of Good Roads, took interested citizens, contractors, automobile manufacturers and city officials through the shops and plants of the bureau and over the streets and roads being repaired by the department.

LAYING TWO-INCH ASPHALT TOP *on macadam base on Western avenue, Chicago.*



THE COMPLETED ASPHALT TOP *on macadam base on Western avenue, Chicago.*

This was the first trip of the kind that any of these men had taken, and the result was encouraging, for it has developed a sentiment and interest in the bureau's endeavors that could not be gained in any other way. It demonstrated that the wheel tax fund was being spent judiciously and that the work was being pursued in a scientific and efficient manner; it also created an interest in the collection of more wheel tax money and the necessity of additional appropriations to help out along the lines of a great improvement. This year's work has completed all but half a mile of a thru route from Chicago to the Lincoln highway, which, with the interest now at its height, may be improved before the close of the season.

WHERE EXPORTS FROM THE UNITED STATES GO

The world's leading importers are the United Kingdom, Germany and the United States, in the order named, France being fourth and the Netherlands fifth. The United States and the United Kingdom are the world's largest exporters, followed by Germany, France and the Netherlands. The United States furnishes about 20 per cent. of the total imports into the United Kingdom, 15 per cent. of those into Germany, 10 per cent. into France, 14 per cent. into Italy, 65 per cent. into Canada, 53 per cent. into Cuba, 50 per cent. into Mexico, 15 per cent. into Argentina and 15 per cent. into Brazil. The Commercial Relations of the United States, a volume of 272 pages, just issued by the Bureau of Foreign and Domestic Commerce, Department of Commerce, contains revised figures showing in detail for the year 1912 compared with the previous year the articles entering into the trade of each country and the commercial transactions with the United States. This volume should prove valuable to those interested in the foreign trade of the United States and foreign countries. Copies may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., for 40 cents each.

FINANCING PUBLIC IMPROVEMENTS

IN PORTLAND, OREGON.

The success of the Oregon method of raising money for public improvements at low rates of interest and small cost to the contractor, and therefore to those who pay for the improvements, warrants this description of the plan and details, from data furnished by one thoroly familiar with all steps of the process. It will be noted that it is largely in details that the method excels and that the reduction in cost of financing is made. Note particularly that the small denominations of the bonds and their ready transfer, almost as easily as cash, makes them a popular investment for men on salary or wages with a little surplus.

THE provisions of the charter of the city of Portland, Oregon, concerning the financing of municipal improvements have had so favorable an effect upon the popularity and price of bonds sold to raise the money to pay for the improvements that the plan is well worth the study of municipal officials in other cities and of state legislatures.

The principal features of the charter provisions are as follows:

The owner of any property assessed for street improvement or sewer, at any time within thirty days after notice of such assessment is first published, may file with the city auditor an application to pay in ten annual installments, with interest at the bond rate provided, waiving all irregularities and defects in the improvement and assessment proceedings.

When the docket showing all liens thus assumed is made up as provided, the city authorizes the issue of its bonds in convenient denominations, not exceeding $1,000 each, and in all equal to the total amount of the unpaid assessments for such street improvements and sewers, maturing in ten years, with interest not to exceed 6 per cent. per annum, payable semi-annually. The city reserves the right to take up such bonds upon payment of the principal, with interest, at any semi-annual coupon period, redeeming them consecutively by number, on notice published not less than twice during the preceding month.

Thereafter the owner of each lot who has thus deferred payment of his assessment must pay each year 10 per cent. of the assessment, with one year's interest at not to exceed 6 per cent. per annum on unpaid assessments or installments. Should he neglect or refuse to pay such sum when due and payable, for a period of ninety days, then the whole amount of installments remaining unpaid becomes due and payable and shall be collected in the same manner and with the same penalties as delinquent street or sewer assessments are collected.

The owner of any property having such lien on it may at any time pay into the city treasury the whole amount of such assessment for which such lien is docketed, together with the full amount of interest and costs accrued thereon to the date of payment.

At any time after the bonds become payable the city may redeem them consecutively by number, on notice by publication in the city official newspaper once each week for three consecutive weeks, giving therein the numbers of the bonds which will be redeemed and the time at which such redemption will be made, and after such time so fixed for redemption

no interest accrues or becomes payable on such bonds so notified for redemption.

The contractor, on the completion of his street or sewer improvement, is paid by the city in general warrants, same bearing 6 per cent. interest ten days after the acceptance of the work. In the meantime the property owner is allowed to pay cash or bond the improvement, as he may see fit, and as fast as the cash is paid into the city by the property owners the contractor is notified and he cashes his warrants up to the amount of money they have on hand in this particular fund. After the ten days have expired to either bond or pay cash for the improvement, if the property owner does not take the benefit of either one, he is notified by the city that they will commence foreclosure of the lien unless the property owner pays his assessment, plus the accrued interest up to the time of payment.

About every three months the city calls for sale of bonds covering all the bonded obligations that they may have on hand, and as soon as the sale has been made by the city and cash received, the city notifies the holder of the warrant that they have sufficient funds on hand to take care of outstanding warrants and the interest will cease on or after a certain date.

The city, in selling their 6 per cent. bonds, have been able to obtain a premium up to as high as 5 per cent., altho the bonds are payable on or before ten years at any interest period paying time after the first year, and the life of city bonds has run on an average of five years. This class of investment has proven very attractive to the local banks and they handle all the paper that the city can issue. At least they have done so up to this time.

This method of financing the local improvement work is very satisfactory to the local banks, as they are willing to assist any responsible and reliable contractor, as they understand that they will receive all of their money loaned to the contract within ninety days after the acceptance of the work.

Frank S. Grant, formerly city attorney of Portland, states that during his years of service as city attorney he does not recall a single instance where the bonds failed to bring from a 1 per cent. to a 3 per cent. premium.

The provisions respecting deposit of money in banks are, briefly, as follows:

Any bank in the city with a paid-up capital of $50,000 may apply for a deposit of a portion of the city funds. The council shall determine which bank or banks shall receive the city funds and shall be designated as depositaries of the city funds. As security for these deposits the banks are required to deposit with the treasurer either bonds of the city of Portland, port of Portland or school district No. 1, or well-recognized railroad, street railway, city, county or municipality bonds, the interest upon which has not been in default for a period of six years and the market value of which is such that the net return of the bonds is no greater than 5 per cent. per annum. The face value of these bonds, at all times, must equal the amount of money on deposit by the city.

Banks that offer bonds of the city of Portland, port of Portland or school district No. 1 as security are given preference. Where the banks simply offer state, county, municipality, school or railroad bonds, and do not offer city of Portland, port of Portland or school district No. 1 bonds, the requirement is that the market value shall at all times be kept not less than one and one-fourth times the amount of the deposit. These funds are subject to the order of the city treasurer at all times.

All these provisions make a demand for improvement bonds which has never been fully satisfied, and they prevent sales of bonds at discount or excessive commissions on loans to contractors, so that the contract prices for public improvements are not loaded up with such discounts, as in some other states. Taxpayers, contractors, bankers, purchasers of bonds, are therefore satisfied, one by ease of payment at the same time that the cost of the improvement is not increased by the accommodation (beyond the interest), and the others by the safety of the investment and the satisfactory returns from it.

STOCKYARD REFUSE

REMOVED BY MOTOR

This very interesting solution of a special problem in refuse removal will be of interest also because of the possibilities of modifying the methods for application to such problems as garbage and refuse collection and removal, especially in the more congested districts of a city, and to the delivery and removal of materials in a plant where they must be distributed over or collected from considerable areas.

THANKS to the efforts of our trade periodicals, the horse-using public are at last awakening to the true understanding of the difficulties of economical hauling, and a few more are reorganizing their entire systems to conform to the requirements of the new money-making, labor-saving wonder, the motor truck. All are thinking, and, of course, will eventually adopt the mechanical power.

Realizing that the motor truck or tractor is but a part of the equipment required to solve the problem of transportation of material, and that in simply substituting the motor truck for the horse a comparatively small gain is accomplished, the Mercury Manufacturing Company has entered the field of special haulage and handling machinery. With competent forces of engineers, backed by well-equipped machine shops, they not only manufacture and sell tractors and trucks, but can also design, build and install complete systems of conveyors, elevators, tractors and trailers, exactly fitted to handle material in the most economical manner.

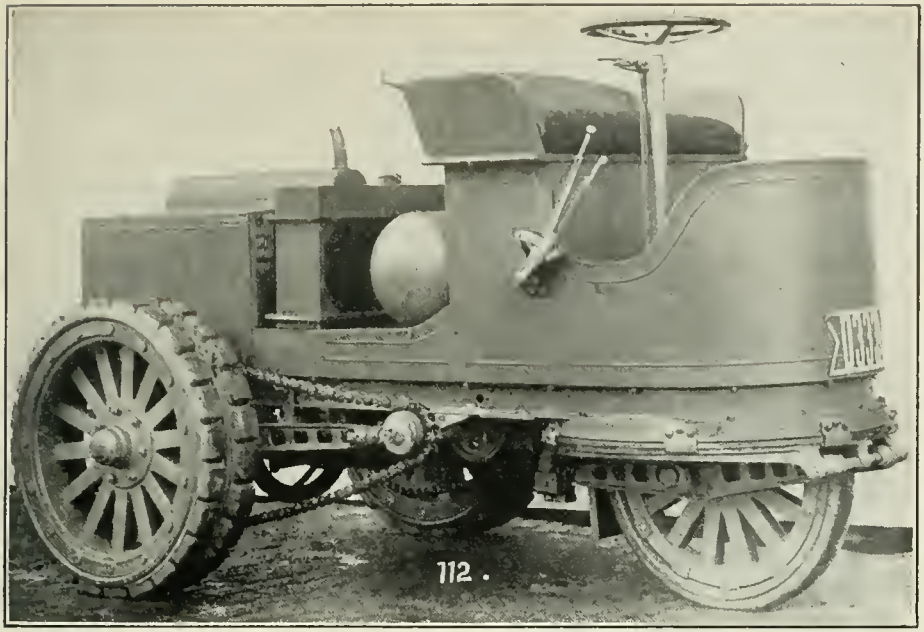
As an example of a more or less complicated case which is being handled, we will describe briefly the manure disposal and cleaning system recently installed in the Union Stock Yards of Chicago.

Up to the present time the work has been done with four-wheeled dump carts, requiring forty teams of horses, valued approximately at $24,000. The carts were loaded in the pens and hauled to a dump at the south end of the yards. The dump was in the form of an elevated platform, made necessary because of the fact that the carts must be elevated and dumped into a freight car, and the incline leading to the dump was steep on account of the small space available.

The average haul is one-half mile, and, of course, the horses were idle during the loading and dumping process, also all day Sunday, Monday and Wednesday, or three-sevenths of the time. With the present system installed, horses are eliminated and replaced by tractors, trailers, snowplows, sweepers and power dumping apparatus. A description of these elements will pe interesting to our readers, and also photographs of some of them.

In the particular installation which we will describe the Bulley tractor is employed. This tractor presents many new and interesting features, and is particularly adapted to this work on account of its compactness and extremely short turning radius, made possible by the three-wheel type, and the fact that the engine is situated over the rear axle, which also aids in giving the remarkable draw pull of nearly one and one-half tons, or over one-half the weight of the completed machine.

The power is derived from a four-cylinder heavy duty motor, which, as stated above, is situated over the rear axle, and between the wheels. On account of the complication of the ordinary type of starter, and because a crank could not be used if situated in the usual position (in this case behind the tractor) because of the train attached to the rear, a modern



THREE-WHEELED BULLEY TRACTOR *used in hauling refuse carts about the alleys in the Chicago stockyards.*

cranker was decided upon, and the starting lever is placed by the driver's seat. This method has proven most satisfactory.

The clutch, of the dry plate type, is placed ahead of the motor and between it and a Cotta transmission, the gears of which are always in mesh, and which is in unit with the differential gears and rear wheels by means of very heavy Diamond chains on hardened sprockets.

The rear wheels are of hickory, and carry 39 by 4 block tires. In slippery road conditions a special non-skid device is placed over the tires, and it has demonstrated that the tractive effort is not lost nor greatly reduced even in the heaviest snow of this locality, when the tractor is used to drag a 12-foot snowplow to clear the way for the trains so that service is uninterrupted.

The front wheel is mounted on an axle to which it is fastened so that the axle revolves with the wheel, and between two heavy cast steel beams, in each of which is a stationary hub holding the ball bearings on which the axle revolves. These beams are fastened together rigidly at the rear, but are mounted on bearings at the front. The rear is held between springs, allowing of vertical motion of the rear end and the wheel.

The bearings work between plates, preventing lateral motion. The bearings at the front, and springs and plates, are connected to a ball-bearing cone, which is larger in diameter than the wheel, so that the center of the wheel is very near in line with the ninety-eight ¾-inch balls upon which the cone works, the balls being held by a stationary cup fastened to the frame of the vehicle.

A dust-washer is provided, also means preventing the cup and cone from separating. To the right of the wheel and fastened rigidly to the cone is a segment of a gear which, working with an adjustable pinion at the end of the steering column, allows of turning cone, beams and wheel.

It is noticeable that it requires less effort to steer this tractor than the ordinary pleasure car.

Two sets of brakes are provided. The emergency brake acts on two drums, one on each jackshaft, by means of a hand lever at the right of the driver's seat. This brake may be set and the service

brake actuated by a foot pedal. The service brake is applied from the foot pedal to a shaft just back of the rear axle with a quick adjustment at the point of attachment. At each end of the shaft is attached a cam, expanding the brake bands in the usual manner. The drums are sixteen inches in diameter, and the bands three inches wide, giving an effective brake area of about 280 square inches.

The Bulley tractor may be had in either electric or gasoline type, and with four wheels instead of three to meet the various requirements of road conditions, turning radius, fire risks, etc., so that the general outline remains the same. The machine is universal as manufactured—that is, within its capacity and working field.

The trailers of this installation are also of the three-wheel type, and weigh when loaded one ton each. When hitched up in trains of twelve they track perfectly, as will be seen from the cut. It is possible, and, in fact, is daily practice, to negotiate a 12-foot alley, turn at right angle to right, and again at right angle to left, so that the first and last few cars are running parallel, while the middle is traveling at right angles to each end. The train may be completely turned around in a 16-foot alley, so that the last cars are running past the tractor going in the opposite direction. The two main wheels of these trailers are of wood with steel band mounted on Hyatt roller bearings. The third wheel is of iron, of the caster type, also mounted on roller bearings, the Bower being used, and pivoted on a cup-and-cone ball-bearing of special design. It was necessary to go into this refinement so that the trailers may be pushed easily by hand when being coupled up into trains, or put into the elevator described later. Chains are provided at the front and rear of each trailer. These chains are fastened at the corners of the cart, and have a combined hook and ring at the intersection of each pair. There is no iron or fastening of any description on the trailers, to accommodate the elevator.

A cut of the special electric dumping elevator is shown in the picture taken with a trailer in the act of being dumped. The elevator receives a trailer, lifts, dumps and delivers it on the train platform automatically. It is driven by its own power in both directions along the track, so that a number of freight cars may be loaded by the same elevator without having to move the cars.

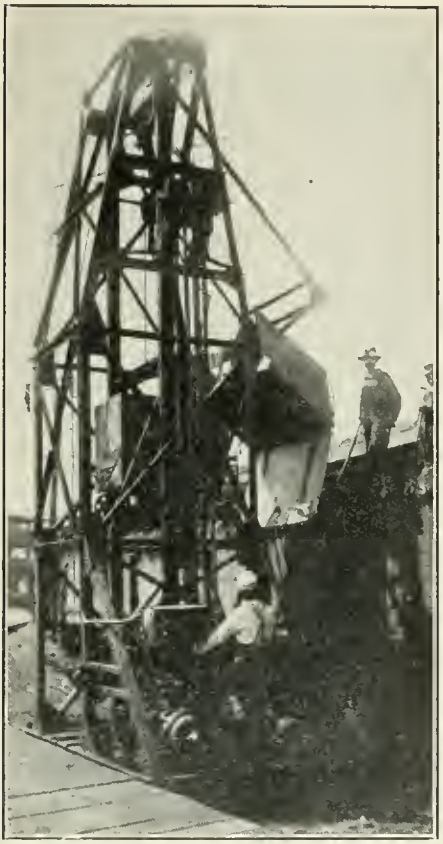
Probably the most interesting unit of this installation is the dumping elevator, three of which will be used in the complete equipment. The elevator consists of a structural steel tower, mounted on flanged wheels, and is self-propelling along the rails parallel to the train of freight cars to be loaded. The machine is electrically driven, power being

REFUSE CARS *in alleys of Chicago stockyards, showing how they follow in train thru the narrow right-angled alleys. Middle section of train is traveling at right angles to the two end sections.*

taken from three overhead wires by means of trolley poles (not shown) and led to the controller-box at the left of the operator thru a metal conduit.

The motor, shown at the left of the operator, is of the induction type, and develops ten horse-power at 900 r.p.m., driving by worm and gear a shaft extending across the frame. A chain from this shaft drives the elevator in either direction according to the position of the switch above the operator's left hand and the clutch, the lever of which is at the right. The operator is standing with his left foot on the quick-acting brake, which will stop the apparatus almost instantly. On the same shaft on which is mounted the clutch, etc., for driving the machine on the rails, are keyed two pinion gears engaging with two larger gears, one of which drives each of the parallel vertical chains, to which a wire rope leading to the cage is fastened. These chains always move together, the object being to give a positive and limited motion to the cage, and also to retard its motion at the top and bottom. The upper chain sprockets are adjustable to compensate for stretch in chain, and for adjustment of cage's vertical movement, which, of course, corresponds exactly with the distance from the top of the upper sprockets to the bottom of the lower sprockets, in this case fourteen feet six inches. The cage is adjusted for position by a twin buckle between the wire rope and the bridle connecting it to the chains.

The cage is a framework of steel having three tracks to accommodate the wheels of the trailers, working against wheels fastened to it, and rolling in two vertical channels. The trailers are pushed into position on the cage, and, striking against spring bumpers at the rear, are adjusted to position by a slight depression in the middle rail and the front wheel. The motor is started and the cage gathers velocity as the wire-rope fastening changes from a horizontal to a vertical motion in going around the upper sprockets the first quarter of a revolution of these sprockets, when it has reached the maximum speed of sixty feet a minute. This allows of dumping from sixty to seventy trailers per hour, depending upon the condition of the material to be dumped, some freeing itself more readily from the carts than others. The cage continues its upward motion at a uniform speed, and as the upper end of the trailer reaches a point opposite the apron on which the load is dumped, it is engaged by a balanced pivot angle, so the motion of this end of the trailer is arrested, with the result that the two main wheels roll toward the front, and the front end of the trailer is raised. As the rear end is stationary, the cart is partially inverted and held in that position as the bridle passes over the lower sprockets. The time of dumping is adjusted by the size of these sprockets. As the motion of the cage is



UNLOADING ELEVATOR, *running on track parallel to railroad cars, lifts refuse cars and dumps them into the flat cars.*

reversed the trailer is righted and assumes its normal position on the rails. As previously stated, the trailer has no attachments, and is not fastened in the cage, but the active forces are so balanced that the trailer always hugs the angle and remains in the desired position. The two main tracks of the cage are pivoted at the front, and, as the cage rises, two legs drop down. When the cage approaches the bottom, these legs striking elevate the rear end of the tracks so that the trailer is expelled into the platform. As the trailer leaves the cage the wheels strike levers, tripping the rails, so that the cage is ready to receive the next cart.

The tractor leaves the dump with a train of from eight to twelve empty trailers, distributes them and returns with an equal number of loaded carts.

It will be noted that it is always possible to have plenty of work ahead of the shovel men, which was not formerly the case, and that the trailers are so much lower than the old dump carts that they are loaded with much less exertion on the part of the men.

It has been demonstrated by a side-to-side run, without the knowledge of the workmen, that a single tractor with twenty-four men, including the driver, helper, elevator operators, etc., will do the work of twenty-two teams of horses and thirty-five drivers, dump and shovel men.

The equipment was invented by G. W. Bulley, president of the Mercury Mfg. Co., and is completely covered by patents issued, allowed or pending.

In a later issue we will describe a new method of freight handling, some of the units of which are already delivered, and which is as novel as the above described system.

NEW YORK MUST GO ON CASH BASIS

New York City needs $100,000,000 to pay obligations, four-fifths of which are payable in gold to foreigners. To raise this money it has been necessary to go to the bankers, and a syndicate was formed to raise the money. The city's necessities in securing the refunding of these obligations have given the bankers an opportunity to perform a public service by requiring the city to retrench sufficiently to pay off these refunding bonds in fifteen annual instalments out of the general taxes, so that they will not come up again for refunding.

Moreover, they demanded that many public improvements for which contracts had been let should also be paid for within fifteen years and the money raised by taxes in annual instalments, and, after some modification of their original requirements, the bankers, the citizens interested and the city officials agreed that improvements authorized by the city during 1915 which are not self-sustaining should be paid for 25 per cent. from taxes and 75 per cent. by the issue of one to fifteen year corporation stock. Improvements authorized during 1916 should be paid for 50 per cent. from the tax budget of the next year and 50 per cent. by sale of serial stock; during 1917 they should be met 75 per cent. from the budget and 25 per cent. by serial stock, and in 1918 the full cost of such improvements should be met from taxes.

The bankers announced that the securities were to run one, two and three years. It was believed the high rate of interest would induce many of the foreign holders of the old securities to accept the new ones in exchange, so that little gold will go abroad.

CONTROVERSY OVER ELECTRIC RATES

IN HOUSTON, TEXAS

By Paul H. Sheldon, Houston, Texas.

The same questions have arisen in Houston as in other cities attempting to revise public service rates. The differences in opinion are liable to arise in other cases, as in this, from lack of information and unwillingness to impart information, on one side or the other. If the city will follow the advice of its experts and the company will open its books to them, there need be no such calamity as the establishment of a competing plant, whether private or municipal, and both sides should receive justice and satisfaction.

IN an effort to bring about a substantial reduction in the lighting and power rates in Houston, the municipal government conducted a far-reaching investigation into the cost of producing electric light in various plants all over the country.

The Houston Lighting and Power Company rates for years have been as follows:

Motor supply, 6 cents per kw. hour for primary service and 5 cents for secondary service.

For general commercial service, 12 cents for primary service and 7 cents for secondary service.

For arc lamps, $70 each per year.

Mayor Ben Campbell and the city council employed Lamar Lyndon, consulting engineer of national prominence, and Henry T. Eirod, consulting engineer of Dallas and Houston, Texas, to make thoro investigation of the Houston Lighting and Power Company. After four months' work they reported that the light company from January 1, 1902, to January 1, 1914, had earned $2,688,543 net, or approximately 18 per cent. per annum. Based upon this report, it is the contention of the city of Houston that the light and power rates should be reduced approximately 40 per cent. The experts' report shows that this may be done without lessening the efficiency of the service and still allow the company to pay a profit of 8 per cent. per annum on its investment.

Attorneys for the light company asked 90 days to prepare data in substantiation of their holding out against the reduction. They agreed to date any reduction decided upon later, from April 1, 1914, but notified the city that they would not submit to an arbitrary reduction.

In support of a 40 per cent. reduction the Lyndon-Elrod report states that the city of Houston could erect its own lighting plant, pay the cost of operating it, furnish electrical energy for the use of all city lights as well as for commercial purposes, at rates approximately 40 per cent. less than now charged by the company, and still pay for the plant in five years.

The summary of the Lyndon-Elrod report indicates the original cost of the corporation's lighting plant, the amount that has been spent in improvements, the present value of the plant, rates charged for various forms of service and rates that could be charged on the basis of 8 per cent. per annum returns. The report also indicates what it will cost the city of Houston to construct a municipal lighting plant, equipped with every modern apparatus and new machinery.

The total cost of the properties is shown

in the accompanying table, together with depreciation and appreciation values and resulting present value. The report stated that at various periods the company started depreciation funds, but they were subsequently converted into dividends.

Officers of the company admit that the corporation has made big dividends, but they say it was done by good management and not by "hold-up" rates. Answering the city, the officials state that they are willing to make a substantial reduction in lighting rates to prevent the city from undertaking the construction of a municipal lighting plant, but that 40 per cent. general reduction is too great a sweep at one stroke.

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¶ ADVANTAGES OF MUNICIPAL OWNERSHIP *are advanced by the city officials as one argument for lower rates.*

Mayor Campbell states that one of the principal evils in the light matter which the city seeks to remove is the alleged practice of the company charging the primary rate from a number of small consumers who are entitled to the secondary rate. The smaller consumers are charged the maximum rates, while the large concerns all enjoy the minimum rate of 5 cents.

The advantage of a municipally owned lighting plant as outlined by the city officials is that the municipal government can get money more easily and at a lower rate of interest than a corporation; that bonds of a municipality are usually sold at a premium, while bonds of a private corporation are sold below par. The annual legal charges in the case of a municipal plant are held to be lower, and a smaller operating organization can be maintained. These facts are being advanced in support of a municipal lighting plant for Houston.

The practice of making different rates for different users of electricity in Houston has been and is being subjected to severe criticism. The present maximum rate for general commercial service is 12 cents per killowatt hour primary service. For secondary service it is 7 cents. The city charges that the company has quoted a private rate as low as 3 cents. If an agreement is reached, the city will probably require the company to allow no reduced rates to consumers and there will be no further discrimination in any rates.

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¶ DIFFERENCES IN RATES *according to differences in service and time of service must be taken into account in fixing a schedule.*

This view is expected to be changed, however, by subsequent events. The Lyndon-Elrod report is authority for the statement that it is impracticable and inequitable to make a fixed rate for electrical service to apply to all users. This may serve to change the attitude of the city at a later date on this question. The experts state that the generating and supplying of electrical energy differ, fundamentally, from that of any other industry by reason of the facts that the total output must be manufactured exactly at the instant of demand; must change instantaneously with change in demand; and the demand for any instant is fixed at the will and pleasure of consumers. Since electricity cannot be commercially stored, the boilers, engines, dynamos, pumps, conducting wires and all parts comprised in equipment and distribution system must have sufficient capacity to produce and distribute an amount of electrical energy which is equal to the greatest possible demand that may be imposed on the system at any one instant.

The income, however, is obtained from the total output of the plant for a given period of time, and therefore depends on the average of the heavy and light loads thruout the year. The report states that a consumer who would use current at periods of the day when the load on the power station is light, should purchase electrical energy much more cheaply than one who uses an equivalent amount, but taken at a period of heavy load. In the first case the only increase in station cost due to supplying the customer during periods of light load is the fuel cost, a fraction of a cent per kilowatt hour. In the second case, the consumer who takes his supply at a period of heavy loads on the station costs not only the additional

fuel consumed to produce his energy, but also the additional size of the equipment, the distributing system and possibly the labor required.

As an instance of how the individual load factor has an important bearing on the cost of supply, the example was given: "Consider the cases of one consumer having a 5-h.p. motor which he uses eighteen hours per day, and another consumer having a 40-h.p. which he uses two hours per day. The first man uses 90-h.p. hr. per day while the second man uses only 80-h.p. hr. per day. But the investment required to provide the equipment and transmission system to distribute the current to the owner of the 40-h.p. motor is eight times as great as the investment to cover the requirements of the owner of the 5-h.p. motor. Obviously, the first named consumer is entitled to a lower rate for his current than the second man. His load factor is 75 per cent., while the load factor of the 40-h.p. motor is only 8 1/3."

The attitude of the city officials is not to act arbitrarily in the matter of effecting a reduction in the Houston light rates, but to so bring about a reduction that the company may still make 8 per cent. profit on their investment, without impairing the efficiency of the service.

Upon the completion of the Lyndon-Elrod investigation, which gave the company a valuation to date of $1,524,841.79 on which it was entitled to earn returns, the Houston Lighting and Power Company asked and was granted until August 1, 1914, within which to file an answer.

On July 24, the company filed this answer to the city of Houston, in which the corporation claimed capital entitled to returns of $2,753,584.63 as based upon estimate of company valuation engineers. This amount was $1,228,742.84 more than the amount allowed by the Lyndon-Elrod valuation. The accompanying comparative statement of the Lyndon-Elrod and the company valuations shows that the city's experts charged $499,232.87 to depreciation, while nothing was charged to depreciation by the company's experts.

Upon the filing of this report the city of Houston immediately notified the company that the reduction of light rates for Houston would be determined finally at a meeting of the city council to be held October 1, 1914, said reduction to date from April 1, 1914, and rebates to be allowed citizens on light bills contracted after April 1, 1914. The matter will then be closed unless the company decides to take the question into the courts.

Messrs. Lyndon and Elrod have drawn up rates for light based upon 6, 7 and 8 per cent. returns on the city's valuation of $1,524,841.79.

The city of Houston is continuing its investigation into the cost of constructing a modern municipal lighting system, and city officials intimate that the failure of the company to agree to a satisfactory reduction may result in the city of Houston installing one of the most modern lighting plants in the South. Public sentiment favors the ownership of all public utilities, which would doubtless facilitate the financing of such a project.

COMPARATIVE STATEMENT OF HOUSTON, TEX., LIGHTING REPORTS.

Item	Company Report	City Report
Direct Construction Costs.		
1. Buildings	$110,852.50	$101,320.00
2. Land	64,364.50	46,005.00
3. Equipment	721,014.00	673,760.56
4. Pole lines and fittings	199,419.45	131,320.62
5. W. P. wire	138,026,70	138,399.64
6. Service drops	58,119.05	44,640.00
7. Transformers	137,538.47	101,898.50
8. Conduits	110,660.58	.....
9. Cable	128,332.96	231,271.37
10. Meters	171,784.90	127,297.90
11. Arc lamps	44,345.95	51,396.00
12. Lamp fixtures	2,453.50	3,500.00
13. Wire and fittings in building	16,954.11	.....

14.	Right of way	4,288.00	.....
15.	Furniture and fixtures	9,691.05	9,691.05
16.	Teams, vehicles and automobiles	15,043.28	13,443.28
	Total direct construction cost	$1,932,889.00	$1,673,943.92
	Indirect Construction Costs.		
17.	Engineering	135,302.23	*.....
18.	Insurance during construction	5,323.80	.....
19.	Taxes during construction	14,936.70	.....
20.	Interest during construction	94,389.32	.....
	Total indirect construction cost	$149,952.05	$103,620.27
	Working Capital.		
21.	Working capital—Supplies	47,846.85	48,331.60
22.	Working capital—Cash	50,000.00	10,000.00
	Total working capital	97,846.85	58,331.60
23.	Work in progress	49,495.73	.....
24.	Total physical property	$2,330,183.63	$1,835,895.79
	Intangible Property.		
25.	Unclassified fixed values	.....	151,705.24
26.	Cost to establish business	423,401.00	.....
	Adjustment.		
27.	Sub-total		$1,987,601.03
28.	Deduct land appreciation		38,305.00
29.	Sub-total		$1,949,296.03
30.	Add discarded equipment		74,778.63
31.	Total from city's report		$2,024,074.66
	Depreciation.		
32.	Deduction		499,232.87
	Capital entitled to returns	$2,753,584.63	$1,524,841.79

*6.18 per cent. for the four items together.

TRACTION ENGINES AND TRAILERS OF WAYNE COUNTY COMMISSIONERS, DETROIT, MICH., WHICH TRAVEL REGULARLY OVER THE CONCRETE ROADS, ESPECIALLY MICHIGAN AVENUE, ON WHICH THE COUNTY PLANT IS LOCATED.

ELECTROLYTIC SEWAGE TREATMENT

IN THE BORO OF QUEENS, NEW YORK CITY.

By Maurice E. Connolly, President of the Boro of Queens.

Reference should be made to the editorial on another page for some suggestions regarding the treatment of this article. The authority of a boro of the city of New York bespeaks careful consideration of the results reported, but the failure to obtain some data which are essential to a complete understanding of the situation will lead the reader to suspend final judgment until fuller information is obtained.

THE question of ultimate sewage disposal is at present acute. For years the method of water-borne disposal has been practiced, until today our harbor is polluted to a dangerous degree. The Hudson River and the contiguous waters of the East River and upper bay are assuming the aspect of a gigantic cesspool because tidal action is inadequate to remove more than part of the refuse, the residue, particularly the sludge, settling until at the mouths of some of the sewers a stratum of twenty or thirty feet has accumulated, and no germicidal action of any consequence takes place.

In European and in some American cities attempts have been made to meet these conditions by so-called "disposal plants," the object being to so treat the raw sewage that the effluent would be innocuous, while the solid, or semi-solid residue, would be left in a portable form.

Disposal plants, however, so far have either required a very large area to operate, with the resulting unsightly condition surrounding, or, if the area was curtailed, the efficiency, doubtful at the best, was negligible.

The Metropolitan Sewerage Commission, realizing the areas necessary to treat New York's sewage by any of the existing processes which gave promise of efficiency, were compelled to fall back on the construction of artificial islands in deep water, to which all the sewage would be conveyed by gigantic pumping operations. While this would probably be effective so far as the immediate vicinity of the city is concerned, the cost would be enormous, not only in construction but operation.

The problem then arose of finding a method of treating the sewage which would result in a removable residue, which method would not be in itself a nuisance.

With the hope of solving this problem, Boro President Maurice E. Connolly of the Boro of Queens has had a new method of sewage disposal tested by the chemist and engineers of his office. This method is of an electrolytic character, which promises to overcome many of the difficulties which have been encountered in the past. An experimental station which was installed at the Elmhurst disposal plant in the Boro of Queens last March, has been in continuous operation under scientific supervision of the boro laboratory since that date. These experiments were conducted with a full knowledge of previous work accomplished by the Metropolitan Sewerage Commission. No method of disposing of a sludge other than by taking it away in tank steamers or the delivery directly into the river has been devised.

Under the method tested, the plants would be constructed underground at the foot of each sewer outlet and the effluent discharged directly into the river, sterile and stable, while the sludge from the machines would be removed at once.

By reference to the report which has

been compiled in connection with the tests made, it will be seen that the rivers can be restored eventually to their natural condition and that the public bathhouses that the Department of Health was obliged to close can be opened to the city. Such a high degree of sterility is reached by this process that it will be possible to restore the oyster beds in Jamaica bay, which have been discontinued for several years past owing to the great pollution brought about by the discharge of raw sewage into the bay.

In the Metropolitan Sewerage Commission's report, it is shown that a large amount of sludge, which has accumulated and is accumulating at the outlets of the various sewers, must be provided for in some way. By the proposed method, the sludge is not discharged into the river, but is reduced to a dry, odorless and compact form, in which condition it can be readily handled and removed.

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¶ A RATHER FULL ABSTRACT *of the report of the chemist in charge of the experiment is given to show the nature and character of the work done.*

Following are some extracts from the report of P. M. Travis, chemist of the Boro of Queens, to which President Connolly refers:

The plant for electrolytic treatment of sewage was installed at the Elmhurst disposal plant, Boro of Queens, New York City, on March 26 for the purpose of observing the effect of the electrolytic and electro chemical method devised and patented by C. P. Landreth, of Philadelphia, for the treatment of sewage.

The apparatus used for experimental demonstration was one of the Landreth electrolytic process machines. Its capacity is 25,000 gallons per 24 hours and the dimensions 2 by 4 by 8 feet. It contains 5 banks of electrodes, 10 inches by 18 inches, spaced ⅜ inch apart, with 11 plates to each bank, thus making a total of 55 plates. The first bank of electrodes with which the sewage comes in contact are composed of carbon, while the remaining four are of iron composition. The apparatus is constructed with a heavy cast-iron base, which holds reduction gearing used for operating paddles which rotate between the plates. The action of these paddles insures uniform treatment of the sewage, breaks up all polarization and prevents any deposit from forming upon the electrodes. The power utilized for operating the apparatus was the regular 220-volt 60-cycle alternating current, available at the plant. This supplied, first, a 2-inch centrifugal pump, used to force the sewage thru the machine at the rate of 25,000 gallons per day; secondly, to operate a 5-h.p. motor generator, which in turn operated the machine proper and supplied the direct current used in the process; thirdly, a small motor used for mixing the milk of lime.

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¶ THE CHEMICAL REACTIONS *are given in full, showing the differences between this process and other electrolytic processes.*

The raw sewage is first drawn thru a ⅜-inch screen and after leaving the pump enters the electrolytic machine, thru an opening at one corner of the first plate in the bank of carbon electrodes, passes between the surfaces of the first and second plates and leaves at an opening in the second plate at the opposite corner of the bank. From here it passes between the second and third plates and leaves thru the third opening in the corner of the third plate, and so continues to pass back and forth thru the ⅜-inch spaces between plates of the electrodes until it has passed thru the entire carbon bank.

According to the theory of this process, while the sewage is passing between these electrodes, the sodium chloride (NaCl) present is broken up by electrolysis into its component ions or parts, according to the following equation: $NaCl=Na+Cl$, the sodium ions being liberated at the negative and chlorine ions at the positive plates, whereupon the sodium (Na) and chlorine (Cl) react with the water, forming sodium hydroxide (NaOH), hydrochloric acid (HCl) and hypochlorous acid (HClO) according to the following equations:

1. $2\,Na+2H_2O=2NaOH+H_2$.
2. $Cl_2+H_2O=HCl+HClO$.

By action of the rotating paddles, these resulting compounds are brought together and react as follows:

3. $2NaOH+HCl+HClO=NaClO+2H_2O+NaCl$. The sodium hypochlorite (NaClO) formed by the above given reaction acts as a germicide by oxidizing the organic matter, including the bacteria, the sodium hypochlorite (NaClO) giving off its nascent oxygen and returning to sodium chloride (NaCl) according to equation:

4. $NaClO=NaCl+O$ (nascent state).

The sewage after leaving the carbon electrodes passes between the iron electrodes in a similar manner. At the inlet to the iron electrodes, sufficient milk of lime is pumped into the sewage to make it alkaline. The electrolysis produced by the iron electrodes results as follows: The salts of iron, held in solution by the sewage, are changed to ferric hydroxide, $Fe(OH)_2$, which is coagulant and helps precipitate the colloidal matter. The electric current acts on the calcium hydroxide ($Ca(OH)_2$) causing the Ca ions to appear at the negative pole and the (OH) ions at the positive pole. As the OH ion is not an attacking ion, the electrodes are not decomposed, and the ions unite to form water and nascent oxygen. The oxygen produced being in a nascent stage acts as a germicide and oxidizing agent on the organic matter in solution and suspension. The calcium does not attack the iron, but unites with the water to again form calcium hydroxide (the same form of lime as introduced) and hydrogen. This hydrogen, being in a nascent state, combines with some of the nitrogen compounds in the sewage to form ammonia. The calcium hydrate is again broken up, and once more performs its function, the calcium reuniting with the water to form the calcium hydroxide and hydrogen gas. Thus the action is cyclic and the small amount of free alkali produces oxygen and hydrogen in proportion to the ampere flow of the current, without decomposition of the iron electrodes. At the same time, part of the lime has combined with the calcium bicarbonate in the water to form calcium carbonate in a hydrated flocculent form. It also forms with the carbonic acid in the sewage more calcium carbonate, hydrated. This coagulant, together with the resulting effects of the contact of the colloidal matter with the electrodes, whereby they give up their charges, which tend to keep them in motion, causes a very rapid precipitation of the suspended matter.

This completes the electro-chemical treatment, and the time consumed, as shown by phenolphthalein test, is approximately two minutes. From here the treated sewage is passed into a weir box, so as to provide means to measure the quantity treated, thence into a sedimentation tank, the dimensions of which are 11½ by 7 by 5 feet. Here rapid sedimentation takes place, a clear effluent flowing out at the top, while the sludge is drawn off thru an opening provided at the bottom. Phenolphthalein tests have shown that the clarified effluent leaves this tank in from ten minutes to one-half hour. The clear effluent was then conveyed to a concrete storage tank, which has a capacity of 67,000 gallons, where it was retained for observation, while the sludge was passed thru a press. The effluent and the liquid from the filter press were clear, odorless and non-putrescent, while the compressed sludge had a slight ammonia or lime odor.

The averages of the tabulated results of bacteriological counts of samples taken during the investigation are given in the accompanying tables:

AVERAGE OF BACTERIAL COUNT ON AGAR PLATES AFTER FORTY-EIGHT HOURS' INCUBATION AT 37 DEGREES C.

The total number of bacteria per cubic centimeter in the raw sewage varied from 1,000,000 to 3,600,000.

	May 10.	May 28.	June 2.	Aver.
Sewage directly after electrolytic, bacteria per c.c.	260	420	270	314
Effluent after passing thru small sedimentation tank, bacteria per c.c.	106	30	85	74
Effluent after storage in tank, bacteria per c.c.	170	455	135	254

AVERAGE OF COUNTS ON GELATIN PLATE AFTER FORTY-EIGHT HOURS AT 20 DEGREES C.

	May 28.	June 2.	Aver.
Sewage directly after electrolytic treatment, bacteria per c.c..	1,100	400	750
Effluent after passing thru small sedimentation tank, bacteria per c.c.	250	90	170
Effluent after storage in large tank, bacteria per c.c.	750	667	709

Bacterial removal or efficiency of sterilization is therefore close to 100 per cent.

Additional tests, made to verify the above results, were made and are shown in the accompanying tables for dates in July. All samples were allowed to incubate for 48 hours at 37 degrees C.

Date.	Dilution.	Count of Bacteria.	Bacteria per c.c.	Acid Forming Bacteria. Per c.c.	Count.	Per cent. of Reduction.	
July 14	1,000	1,000	1,000,000	7	7,000		Raw Sewage.
	1,000	1,200	1,200,000	..	.....		Raw Sewage.
	200	....	.....	50	10,000		Raw Sewage.
			199		2		After 20-ampere treatment.
July 20	1,000	2,940	2,940,000	20	22,000		Raw Sewage.
	10,000	360	2,600,000	2	20,000		Raw Sewage.
	.....	†	3,270,000	..	21,000		Raw Sewage.
	.....	....	115	..	.....		After 30-ampere treatment.
	.....	....	75	..	.....		After 30-ampere treatment.
	.....	†	95	..	.....	99.997	After 30-ampere treatment.
					12	99.943	After 30-ampere treatment.
July 22	10,000	136	1,360,000	11	110,000		Raw Sewage.
	1,000	1,220	1,220,000	..	.....		Raw Sewage.
	.....	†	1,290,000	..	.....		Raw Sewage.
	.....	....	1,560	..	.....	99.879	After 20-amp. 7.5-v. treatment.
					2	99.998	After 20-amp. 7.5-v. treatment.
	10,000	113	1,130,000	11	110,000		Raw Sewage.
	1,000	1,020	1,020,000	105	105,000		Raw Sewage.
	.....	†	1,075,000	..	107,500		Raw Sewage.
	.....	....	1,040	..	.....	99.819	After 30-ampere treatment for 1 hour 15 minutes.
	.....	....	1,400*	..	.....		After 30-ampere treatment for 1 hour 15 minutes.
	....	....	.....	..	28	99.974	After 30-ampere treatment for 1 hour 15 minutes.

The observations of the amount of dissolved oxygen in the samples, in parts per million, showed the following results at the same times, the report giving many prior determinations:

	Dissolved Oxygen in p.p.m.	Temperature.	Per Cent. of Saturation.
July 20—Raw Sewage taken at 11.30 a. m.	3.95	16 deg. C.	39.70
July 20—Treated effluent taken at 11:30 a. m. from sedimentation tank after treatment of 20 amperes	2.06	18 deg. C.	21.59
July 20—Raw sewage taken at 1 p. m.	0.00	16 deg. C.	0.00
July 20—Treated effluent taken at 1 p. m. from sedimentation tank after treatment of 30 amperes	2.71	18 deg. C.	28.41
July 22—Raw sewage taken at 10 a. m.	0.00	15 deg. C.	0.00
July 22—Treated effluent taken at 10 a. m. from sedimentation tank after 20 ampere treatment	5.26	18 deg. C.	55.14
July 22—Raw sewage taken at 11:15 a. m.	4.52	15 deg. C.	44.53
July 22—Treated effluent taken at 11:15 a. m. from sedimentation tank after 30 ampere treatment	5.42	18 deg. C.	56.81

Additional tests made from July 20 to 22, inclusive, of oxygen consumed in parts per million showed the following results:

July 20—Raw sewage taken at 11:30 a. m. 61.6
July 20—Effluent from sedimentation tank at 11:30 a. m. after 20 ampere treatment 19.58
July 20—Raw sewage taken at 1 p. m. 133.76
July 20—Effluent from sedimentation tank at 7 p. m. after 30 ampere treatment 26.4
July 22—Raw sewage taken at 10 a. m. 268.95
July 22—Effluent from sedimentation tank at 10 a. m. after 20 ampere treatment 13.09
July 22—Raw sewage taken at 11:15 a. m. 68.20
July 22—Effluent from sedimentation tank at 11:15 a. m. after 30 ampere treatment 17.82

Much of the reduction is doubtless due to the oxidation of the organic matter which takes place in the electrolytic treatment.

It is interesting to observe that when the sewage is concentrated the dissolved oxygen content is considerably increased by the electrolytic treatment, and that the oxygen consumed by the organic matter is enormously reduced, as, of course, would be expected after such treatment.

Results of Chemical Examinations of Sewage Before and After Treatment.

	Date	Raw Sewage	Directly After Treatment	Effluent from Small Sedimentation Tank	Effluent from Large Storage Tank
Nitrogen as Nitrites	May 19	0.40	0.40	0.56	5.00
	May 20	0.40	0.40	0.80	5.00
	May 23	0.56	0.56	0.72	5.00
Nitrogen as Nitrates	May 19	4.00	4.00	4.00	0.00
	May 20	1.60	1.60	1.60	0.00
	May 23	0.00	0.00	0.00	0.00
Nitrogen as Free Ammonia	June 2	33.00	.....	25.00	21.00
Total Nitrogen by Kjeldahl Method	June 2	70.00	.....	42.50	32.50
Chlorine Content	May 19	140.00	140.00	140.00	140.00
Turbidity	May 27	270.00	.....	55.00	15.00
	May 28	165*b*	.....	33.00	15.00
Color	May 27	124*a*	.....	33*a*	33*a*
	May 28	100*ab*	.....	27*a*	29*a*

a. Color is given in units on the platinum-cobalt scale.
b. After a heavy rain.

The nitrogen as nitrites in the effluent remains constant thruout the treatment, but increases upon storing and the nitrates decrease to zero. The decrease in the large tank of free ammonia and dissolved oxygen, as illustrated in the above tables, is perfectly consistent with the increase in nitrites, this being due to the breaking up of the ammonia and the oxidation of the nitrogenous matter by the dissolved oxygen in the water.

On May 28, samples were taken to determine the stability of the sewage after treatment. These samples were colored with methylene-green and allowed to incubate at 37 degrees C. On June 10, a sample of the effluent from the small sedimentation tank and also a sample from the large storage tank were removed from the incubator, having shown no signs of losing their color, thus showing that the effluent, after the electrolytic treatment, was non-putrescible.

The chlorine value thruout this treat-

ment remains constant; in other words, if the sodium chloride is converted into hypochlorites when in contact with the carbon electrodes, then in all probability it returns to its normal condition before the sewage treatment is completed, showing that the presence of chlorine ions is constant at all stages of sampling.

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¶ THE CONCLUSIONS *drawn in the report are most detailed in regard to the lime used in the process, perhaps because the amount used is so much more than is usual in sewage treatment.*

Detailed results of examinations for following the lime thru the process are given in the report which then presents the following conclusions:

Using the value of 7.8557 lbs. as the average lime content of the mixing tank, the quantity of lime which is pumped in twenty-four hours for the 25,000-gallon treatment, which is the condition under which these tests were made, is 31.4228 lbs., this giving a value of 1256.9 lbs. of lime per million gallons. Deducting the quantity of lime which it is necessary to use in softening the water, we have a value of 761.2 lbs. As 171.7 of lime as calcium oxide still remains in the large tank according to previous analytical data, this leaves 589.5 lbs. of lime which is actually consumed in the electrolytic treatment of sewage at Elmhurst. As calcium oxide is the active agent in the lime used, the actual cost per ton of lime used in this treatment would be in direct ratio to its purity. The lime used in the above experiments was 78.56 per cent. pure calcium oxide; thus to obtain the 1,256.9 lbs. of pure calcium oxide used per million gallons, it would be necessary to use about 1,600 lbs. gross of lime of this quality.

The cost of treating Manhattan sewage by this process would be much less than in Queens Boro, since analysis shows that this water contains only 3 p. p. m. of free carbonic acid and 33 p. p. m. total alkalinity calculated to calcium carbonate. From the above data it is readily seen that it would require 180 lbs. of lime per million gallons to soften this water. It would therefore require 315.7 lbs. less lime per million gallons than we are using in the Boro of Queens. Upon the basis of these calculations Manhattan sewage, if treated by the same process, would require 941.2 lbs. per million gallons for treatment.

It is also well to note that the time of sedimentation of the suspended and colloidal matter from the sewage after treatment by this process is reduced to a minimum. It requires less than an hour for complete sedimentation, thus eliminating the necessity of extensive sedimentation tanks and filter beds. The sewage treated for the above tests is normal domestic sewage with the exception that the contents of the cesspools of the locality are being carried to the plant and dumped into the receiving well at the rate of some hundred tank-wagon loads per day.

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¶ ODORS ARE ELIMINATED, *but the difficult sludge problem is not treated fully in the report.*

After the sewage enters the electrolytic apparatus there is no further offensive odor whatever from it. This method requires a small space, and the complaint of nuisance caused by the usual methods is avoided. An apparatus for treating 1,000,000 gallons in twenty-four hours is but 23 feet long, 4 feet wide and 3 feet high. It lies horizontally on the floor, the sewage flowing lengthwise with the electrodes, the paddles rotating in the direction of the flow of the liquid and actuated by the driving mechanism on the outside. Along the bottom of the box containing the electrodes pockets are arranged to catch the sand, with provision to draw it off, where it may be discharged into a receiving well.

In regard to the action upon the metallic plates which are used in the electrolytic machine, a composite sample taken every half hour on May 28 for a period of twenty-four hours showed an increase of only 2.06 p. p. m. of iron, thus showing that the electrolytic action on the iron plates is very small, this fact, no doubt, being brought about by keeping the sewage akaline with lime so that the hydroxile ions are in excess over the chlorine ions, thus overcoming the attack of the chlorine upon the iron plates, which

has been cited in previous electrolytic processes as one of the main drawbacks. The current used and generated by the motor generator for electrolysis on a flow of 25,000 gallons of sewage daily is 18 to 20 amperes, with a pressure of 7½ volts, or a power consumption of 135 to 150 watts, which is about 1.5 h. p. The carbon electrodes take about 0.9 of the current, the balance going to the iron electrodes; hence out of 20 amperes 18 go to the carbon and the remaining 2 amperes are seriesed eight times on the iron plates, giving an efficiency of 16 amperes on the iron. Estimating the power required per million gallons from the above figures, and remembering that with the increase of plate area in larger machines the voltage required to put thru a given amperage is proportionately reduced, about 6 k. w. should be sufficient to effect the high degree of purification obtained in these tests.

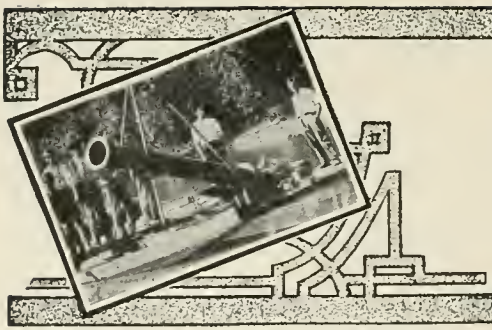
Without including pumpage, the necessity of which would have to be determined at each point of treatment, according to topography, the cost of electricity for electrolysis at the rate of six kilowatts per million gallons at a cost of 3 cents per kilowatt hour would be:

6 x 24 x .03	$4.32
Lime, 1,257 lbs., x .003	3.77
	$8.09

The attendance of these machines requires no high degree of technical skill and determination of the sanitary efficiency of the process at any moment is simple, since it is visibly manifested by the coagulation produced. It is necessary only to keep the sewage slightly alkaline by regulation of the lime and this can be tested in a moment with a drop of phenolphthalein which turns pink in alkaline solutions.

BANKING AND CREDIT SYSTEM IN SOUTH AMERICA

A manufacturer's view of the financial environment of the trade of the United States in Argentina, Brazil, Chile and Peru, given in a bulletin just issued by the Bureau of Foreign and Domestic Commerce, is of special interest at the present time, when American manufacturers are looking to that field for enlarged business. No attempt is made in the bulletin to provide a technical banking report; the facts presented concern the financial conditions surrounding American trade, the disadvantages under which our exporters labor, and the experiences of other nations that have considered oversea banking operations essential to their conquest of foreign trade. The bulletin contains lists of the principal foreign and native banks in these countries, a brief description of their monetary systems, a summary of their foreign trade, a brief outline of their banking laws, and a discussion of banking practice, credit-information service and exchange methods. A chapter is devoted to a discussion of the various methods suggested for establishing American banks in these countries and their field of operation. Copies of the bulletin (Special agents' series No. 90) may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., for 10 cents each.



EDITORIAL

THE MANUFACTURER AND THE NEW MARKETS.

Further observation and discussion shows the pertinency of last month's editorials on the manufacturers' present opportunity in foreign markets and that these markets are by no means restricted to other American nations, but are to be found all over the world, including the European nations, both those at war and those at present in peace. While the Government is doing all it can by promoting direct lines of steamers and branch banks and correspondents, as well as business agents in Government employ, it cannot supply the manufactured materials, nor, except in part and by way of advice, determine the individual methods of developing trade, packing and shipping goods, making collections and the like. These are the parts of the business which must be done by the individual manufacturer either directly or thru his authorized agents.

The same attention to taking care of the trade is necessary as with home trade, modified in accordance with local customs and prejudices, and really no more. The customs and prejudices are different, that is all.

Some observers, who are impatient at the apparent slowness of comprehension by the average manufacturer of his wonderfully and instantaneously enlarged opportunities, are disposed to complain because he does not rush in at once, but waits, seemingly to see what the results of the war will be. This state of mind is quite natural and is due to the average man's ignorance of foreign trade and its many peculiarities; to his fear, based on many years of large stories about the greater business ability of foreign merchants, particularly English and German shippers, that he cannot compete with them when they get back into the field; and to the consequent fear that he will ultimately, if not soon, lose the money he puts into the development of foreign business.

He may know of the successes of large corporations in foreign trade, such as the agricultural implement men, saw and saw-mill men, plumbers' goods makers, oil men, etc., but he cannot apply this knowledge to his own case, since his business is and must always be so much smaller.

There seems to be room, therefore, for organizations which can make the connections between the manufacturers in the United States and the customers in other countries. Organizations can do on a large scale what

single firms would not be justified in doing. They can establish the necessary agencies for promoting the use of goods, for keeping stocks of goods in the centers of distribution of each country, for passing upon credits of prospective customers and for making collections. They can prepare the necessary advertising material in the various required languages and distribute it, can make specifications for manufactured products to suit the needs of the customers, and for packing and shipping to meet transportation and custom-house requirements; see that manufacturers fulfil their contracts in these and other respects, and make the inevitable adjustments, when satisfaction is not given from accident or other cause.

Such an organization must be so constituted as to have or be able to gain promptly the confidence of both seller and buyer and should therefore have the best of financial rating in every country in which it does business and must go into the business to stay.

Such organizations are now in process of formation, some with ample provision for all parts of the business and others beginning with little knowledge of conditions and little capital on which to learn the business. Honesty and straightforward attention with equal assiduity to the business of all its patrons, both buyers and sellers, are the first essentials. The Chicago office of MUNICIPAL ENGINEERING is in position to give some valuable information in these lines.

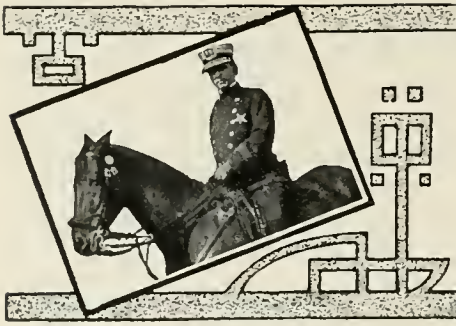
ELECTROLYTIC SEWAGE TREATMENT.

The official report of experiments in Queens Boro, New York City, with an electrolytic method of treating raw sewage, extracts from which are printed on another page, gives results which seem to be almost too good to be true. A careful study of the report and perhaps of the abstract will cause the reader to take the conclusions of the chemist, Mr. Travis, with some reserve until further information, as to portions of the process and its results not reported upon, is obtained and full estimates of cost are provided.

Thus there are discrepancies in statements as to amounts of electricity required and used, and no account is taken of the disposal of sludge, tho, judging from the results of chemical precipitation by means of lime, using perhaps half as much as in this electrolytic process, the disposal of sludge will be a very difficult problem, quantity alone being considered.

Again, the estimates of cost only include the cost of current and of lime, ignoring cost of operating the apparatus, renewing parts of the electrolytic apparatus, removing and disposing of sludge, and overhead charges, so that no definite comparison of relative efficiency, including economy, of this process with others in use can be made with the data at hand.

The indications are of interest, and point to further detailed experiment under careful measurement and accounting of costs as well as bacteriological investigations.



QUESTION DEPARTMENT

How to Fix Water Rates

Will you please suggest means of ascertaining the basis on which water rates are fixed in various communities of 30,000 to 50,000 people? Our citizens association feels that the local rate is too high, but even the recent publication by a committee of the American Water Works Association does not give us a properly detailed explanation of rates so that we can use that as an argument before our State Corporation Commission.

P., ———, Va.

In the past the tendency has been to make the charges for service by a public service corporation what the traffic would bear, the service very often being worth actually more than could be charged for it. But since it has been recognized that the services rendered are true monopolies and must be so treated if full economy is practiced, and that these monopolies belong to the people who have granted permits to operate them, the practice has been to base the charges on the cost of the service rendered, when all the elements of that cost have been considered.

In the case of a water supply the cost is made up of the following principal elements, with many minor items of related nature:

The cost of the property, including real estate, water plant, reservoirs, lakes, wells, conduits, pumping stations, distribution pipes, service pipes, meters, etc. The annual cost of this item includes interest, sinking fund, depreciation, maintenance and repairs, etc.

The annual cost of operating the plant, including fuel, labor and materials, keeping of accounts, billing and collecting, inspecting, purification, etc.

The total annual cost of supplying the water is thus obtained quite accurately, much of it from the books of the company showing expenditures and much from rules and customs now becoming well standardized.

Rates for water to produce revenue sufficient to meet all these expenditures and charges, and only enough more to supply a reasonable fund for accidents, fluctuations in business, and the like, can then be worked out. The proportion which the city should pay is now quite readily obtained by methods which have been standardized. Given the schedules of rates in force, they can be decreased or increased proportionately to bring the gross revenue to the figure required, or the opportunity can be taken to revise any of the rates which seem to be inequitable.

Future developments may change conditions so that the rates thus fixed may become inequitable. Provision is made for revision of any rate or rates when this develops. The increase or decrease in value of the franchise belongs to the community, and it should profit by the one or lose by the other. Rates should therefore be increased or decreased to put the burden where it belongs. In one or two places a safety fund is provided for, and when this fund decreases below a certain fixed amount or increases above a certain other fixed amount, the rates are automatically increased or decreased by a unit or a percentage. In most cases, however, the rates continue as fixed until their inequity becomes too apparent to be ignored and one party profits and the other suffers during the time that this inequity is developing to the acute stage.

The above is a brief statement of some of the principles underlying the determination of rates. There are many details which have been discussed very fully by engineers and attorneys interested in the various cases which have arisen. Perhaps the source of the fullest information is the publications of the Wisconsin Railroad Commission and its members. Several members of the commission, past and present, have written papers summarizing the results of their labors. If these reports are not available in local libraries, most of them can be obtained from the commission at Madison, Wis. Copies of the papers and lectures by commissioners can also be obtained from them.

So far as water rates are concerned, the publications of the American Water Works Association for several years have contained excellent developments of various parts of the many subjects involved.

These can be obtained of the secretary, John M. Diven, Troy, N. Y.

The back numbers of MUNICIPAL ENGINEERING are full of articles on this line. Thus in the last volume, xlvi, are the following:

"Pasadena's Electric Light Plant," p. 41.

"Effect of State Regulation of Public Utilities," p. 168.

"Compensation for Telephone Franchise," p. 378.

"Securing an Equitable Franchise for Public Utilities," p. 380.

"Modern Contracts with Public Service Corporations," p. 460.

"Comparison of Operations of Private and Municipal Plants of Pasadena, Cal.," p. 462.

"Rate Making for Public Utilities," p. 520.

"Regulation of Capital and Rates of Public Service Corporation," p. 571.

Expansion of Concrete

Will you kindly inform me as to the theory of expansion and contraction of concrete. Is there provision for expansion in all concrete work or is there only a certain class of concrete work which is provided with expansion joints. I have seen concrete roads in Pennsylvania and Connecticut and these had an expansion joint every fifty feet transversely across the road. Recently I have seen the great Yale Stadium in the course of erection and have been told by an inspector there that in the lower wall, the large retaining walls and all of the tunnels, thirty in all, there is no provision for expansion. There was some provision made in the construction of the seats. This, he explained, was done to allow for the settling of the earth, being on a fill, rather than for expansion and contraction. I understand that the construction of roads is different from the construction of walls, but I would like to know when and where expansion joints should be provided, if it is the best practice to do so. S., Philadelphia, Pa.

The expansion of concrete per degree of increase in temperature is not far from that of steel. It must be provided for in some way. If the variation in temperature is slight, the provision required will be less than if that variation is large. Not only expansion but contraction must be provided for, and it is probable that most of the so-called expansion cracks in concrete are really contraction cracks.

A wall or a pavement exposed to the sun requires much more ample provision for expansion and contraction, if cracks are objectionable, than a mass of concrete or than floors or walls which are inclosed and not subject to great variations in temperature. Indeed, the allowable changes in form of a structure and the ability of the concrete to withstand internal strains, compressive and tensile, may in many cases of the latter sort be sufficient to prevent any injury.

The temperature cracks in a road surface are due to contraction and to expansion. The longitudinal cracks are probably due to expansion, which causes the arch made by crowning the roadway to rise, and, when and where it breaks, the crack is formed. The concrete not being laid at the lowest temperature to which the road is subject, the contraction of the concrete is most to be feared in the longitudinal dimension of the road. Since the tensile strength of the concrete is much less than its compressive strength, contraction cracks are almost sure to appear at intervals of 30 to 50 feet. For this reason so-called expansion joints, which are really contraction joints, are put into the road from 30 to 50 feet apart. Since the road is ordinarily laid in the summer season, the expansion under summer heat can ordinarily be taken up by the ability of the concrete to withstand the compressive stresses caused by the increase in temperature, and real expansion joints are usually not needed. In brick pavements laid in cold weather there have occasionally developed breaks and even explosions due to such expansion. The same have occurred in cement sidewalks, and will doubtless occur in concrete streets wherever a change in grade is made or a break in continuity of surface by changing form of cross-section at a street or alley intersection. These cases are comparatively rare, but are worse in concrete walks and streets than in brick, because the expansion of concrete is approximately double that of brick per degree of increase in temperature.

Some engineers are using some of the lighter forms of steel reinforcement near the outer surfaces of concrete pavements and walls to carry the tensile stresses set up by reductions in temperature, hoping in this way to reduce the number and size of temperature cracks, and they have met with considerable success.

An outside wall, especially a retaining wall, which is not so free to move as the wall of a building, is subject to the same expansion and contraction under changes of temperature as the pavement, and if its ability, plain or reinforced, to resist internal stresses, or its freedom to move is not sufficient, cracks will develop, which, again, will ordinarily be contraction rather than expansion cracks.

It should be noted that the term "temperature cracks" is ordinarily used, not to apply to the thru cracks covered by this discussion, as it is used above, but to cover the fine or superficial cracks of no serious depth due to the greater changes in temperature in the surface of the wall than in the wall as an entirety.

Each concrete structure has its own expansion and contraction problems. Most of them are taken care of in reinforced concrete buildings by the reinforcement

and by the comparative freedom for the changes in form due to changes in temperature. In other structures, the reactions against foundations and surroundings, the internal stresses in walls, floors, arches above or below, reinforcement, etc., must be designed to reduce or remove to a reasonable distance the danger of cracks, or they must be localized, as desired, by proper joints. It is evident, therefore, that any important structure should be designed by an engineer with education and experience in the qualities of concrete, plain and reinforced, with full consideration of the tendencies toward changes in form which will occur with changes in temperature.

Ordinance Establishing Municipal Market

This organization is investigating the city market question with a view to establishing a market in this city. It has occurred to me that you may be able to refer us to some interesting articles on the subject.

RAYMOND B. GIBBS,
Secretary Chamber of Commerce,
Olean, N. Y.

The most exhaustive study of marketing conditions and methods of meeting them which has been made recently and on modern lines is that of the Chicago Municipal Markets Commission, of which Alderman James H. Lawley is chairman. Copy of it can probably be obtained from him or from the Chicago Association of Commerce. A brief review of the conclusions of the report and the proposed revision of the Chicago marketing system will be found in the September number of MUNICIPAL ENGINEERING, vol. xlvii, p. 238.

The mayor of Des Moines, Ia., made some excellent reforms in the operation of the public market in that city, which he has described in lectures delivered at various places. Probably he could supply at least a newspaper report of the lecture and some hints as to matters to avoid and to insist upon in the establishment of a market.

There are two main reasons for establishing a city market, one to bring producer and consumer nearer together, and the other, most closely related, to keep prices down by eliminating the commission merchant from the market and preventing combinations in restraint of shipment of perishable foodstuffs into the city.

Rochester, N. Y., has a very successful wholesale market which more than pays expenses and controls prices to a considerable extent. But a small city needs a retail market and may need to restrict wholesaling or the purchase by commission merchants of market commodities from farmers on their way to market, "forestalling," as it is called in market ordinances of a past generation. Stalls in a market should be rented at low prices and for such terms that the producers can afford to rent them. On the other hand, local merchants may have just cause for complaint if the stalls are free.

In one city where the market was operated in such way as to pay expenses only, a new administration made some large improvements and desired to repay itself for these improvements. It was soon found that higher rents for stands could not be charged unless the stands were rented by the year. They then fell into the hands of commission merchants, their agents or aids, farmers requiring them all the year not being numerous, and the farmers were crowded out to stations along the curb during the growing season. The city made money, but the combinations pushed up prices until most of the advantage as to prices was lost.

The city of New York has made some valuable reforms in its municipal markets recently, one making them free, and results are reported to be excellent. These have not been under way long enough to be reported other than in the daily and weekly press. Information can be obtained on application for it thru the mayor of the city.

An illustrated description of a handsome little concrete market at Ft. Wayne, Ind., will be found in MUNICIPAL ENGINEERING, vol. xlvi, p. 288.

Clinton Rogers Woodruff, secretary of the National Municipal League, North American Building, Philadelphia, Pa., can give valuable information on the problem of establishing municipal markets.

A full market ordinance is too long to print here, but the following outline may be of service:

Location is defined, describing buildings, areas and curb lines bounding market spaces on streets and adjoining sidewalks and property.

Plats of stalls and stands are provided for from which to locate stands and leases.

Definitions are given for such terms as City Markets, Stalls, Benches, Stands, Curbstone Stands, Marketer, Engrossing, Forestalling, Regrating.

Appointment and duties of market master are provided for.

Market master's duties are defined, and he can enforce cleaning of stalls, settle disputes, etc., and is given special police powers.

Market days and hours are fixed.

If the city does not have an inspector of weights and measures, the market master should be provided with standards and enforce them.

Annual fees for stalls, etc., inside market houses, and daily fees for outside and

curbstone stands are fixed annually by board. Provision that stands be auctioned off to highest bidders is probably not good, as it tends to force out those specially wanted in the market and to develop combinations to fix prices.

Forfeitures of leases are provided.

More than one stand not rented to a single tenant except on special grant by board.

Transfers of leases are forbidden.

Barring of marketers, revocation and surrender of leases and leasing of surrendered stands are provided for.

Standing of horses and vehicles about and near market and at curbstone is regulated.

Unrented stalls can be rented on daily payments.

Stands outside defined market limits are prohibited, also use of market stands or spaces without lease, daily or annual.

Cleaning of stands by occupants is required.

Sale of meat is regulated, also cleanliness of stalls used therefor.

Selling or buying from stands before market hours, forestalling, engrossing, regrating, presence of dogs in market, stationing wagon before midnight, sale of unwholesome provisions, meat, fowl or fish, bull, boar or ram meat, unfresh eggs, are prohibited.

Shape and size of dry measures are defined.

Killing of animals, fish or fowls in stand, trespassing in stall, disfiguring market house, hitching to market house, obstructing passageways of or streets near market house or sidewalks, idling about market house, sales from vehicle without license, auction sales, itinerant venders and outcrying goods are prohibited.

Penalties are provided for violation of provisions of ordinance.

Garbage Reduction Systems

I would like to have a list of names of manufacturers of garbage disposal plants, of sizes suitable for cities of 100,000 population, that treat and handle the garbage to turn it out as fertilizing material.

S., ———, Iowa.

The firm named manufactures apparatus and builds plants for garbage reduction and has some patents on machinery and processes. This method of disposing of garbage seems to be of particular value in the larger cities of more than 100,000 population, tho one small city, of about 15,000 population, has a reduction plant on the Wiselogel system which is reported to be successful.

Cleveland and Columbus, O., have municipal garbage reduction plants which are said to be financially successful, tho cost of collection is not considered and no comparisons of total cost of collection have ever been made between their systems and others. The Cleveland plant has machinery made by the company mentioned by our correspondent, and possibly also the Columbus plant. The latter plant was designed by I. S. Osborn, an engineer of experience in the construction and operation of garbage reduction plants, and was operated by him until it was in full working order, and it contains machinery made by several of the manufacturers mentioned in the answer to another question on this line, appearing in this department this month.

These two are the only municipally operated garbage reduction plants known to the writer, but there are many in operation by private companies.

Schenectady, N. Y., has just completed a garbage reduction plant, the success of which will soon be tested. It is a city of less than 100,000 population.

Cincinnati, Dayton and Toledo, O., Boston and New Bedford, Mass., New York City, Baltimore, Md., Philadelphia, Pa., Newark and Atlantic City, N. J., Wilmington, Del., Detroit, Mich., Indianapolis and Vincennes, Ind., Washington, D. C., Syracuse, N. Y., Reading, Pa., Rochester, N. Y., are among the cities which have had greater or less success in letting contracts to companies for the reduction of garbage.

MUNICIPAL ENGINEERING has published a number of articles on garbage reduction and other methods of disposal. In the current volume, xlvii, are the following: "Street Cleaning and Refuse Disposal in Philadelphia," p. 19; "Profitable Conversion of City Garbage," p. 25; "Vancouver Garbage Collection and Disposal Ordinance and Methods," p. 41; "The Harris Municipal Garbage Incinerator and Steam Generator," p. 72; "Garbage Incinerators and Destructors," p. 114; "Garbage Disposal by the Hirsh Chemical System," p. 131.

Several articles will be found in the preceding volume, xlvi, and on p. 237 is a list of the more important articles in several earlier volumes.

Coal Pulverizing Machinery for Cement Manufacture

Can you give me the address of one or more reliable parties or firms making a business of designing complete outfit for powdering coal, as used for burning cement in rotary kilns?

Will you kindly advise me, if you can, the minimum, average and maximum weight of powdered coal, required, in general use for burning a given quantity (if barrel, give number of pounds) of cement clinker?

L. M., Philadelphia, Pa.

Among manufacturers of coal pulverizers of various sorts are the Jeffrey Mfg. Co., Columbus, O., who make pulverizers

for use in the fuel plants as well as the cement-grinding plants of cement mills; Allis-Chalmers Co., Milwaukee, Wis.; Abbe Engineering Co., New York; C. O. Bartlett & Snow Co., Cleveland, O.; Bethlehem Foundry and Machine Works, South Bethlehem, Pa.; Bonnot Co., Canton, O.; Bradley Pulverizer Co., Boston, Mass.; Geo. V. Cresson Co., New York; Power and Mining Machinery Co., Cudahy, Wis.; F. L. Smidth & Co., New York; Strong, Carlisle & Hammond Co., Cleveland, O., and many others.

The amount of coal used in burning cement varies according to the kind of kiln used, whether wet or dry process is used and the kind of coal, from, say, 12 per cent. of the weight of the clinker produced to 60 per cent. Including the coal used in producing the power used about the plant, it is sometimes roughly stated that a pound of coal is required to produce a pound of clinker, but this is usually an exaggeration. The rotary kiln requires from 100 to 175 pounds of coal to produce a barrel of finished cement, 376 pounds of cement at 94 pounds per sack, and may under favorable circumstances shale the lower figure, counting only coal used in the kiln.

Topeka Specification Asphaltic Concrete

Can you inform me as to what is the largest size aggregate and what is the largest percentage of it that may be used in "Topeka" mixture or asphaltic concrete without infringing on the Warren Brothers patents? Also, if any asphaltic concrete even if containing large sizes of aggregate does not infringe on these patents if not used for wearing surface. I would appreciate any information you can give me on this.

A., City Engineer, ———, Ariz.

Several questions of this nature having been asked, the following, which is reported as from the decree in the Topeka case, and to constitute the so-called Topeka specification, is given:

"Any pavements hereafter constructed in substantial compliance with the following formula, to wit:

"Bitumen from 7 to 11 per cent.

"Mineral aggregate passing 100-mesh screen, 5 to 11 per cent.; 40-mesh, 18 to 30 per cent.; 10-mesh, 25 to 55 per cent.; 4-mesh, 8 to 22 per cent.; 2-mesh, less than 10 per cent., sieves to be used in the order named, would not infringe the claims of said patent."

The Association for Standardizing Paving Specifications adopted a specification for asphaltic concrete which they thought would give the best results, but refused to pass upon its freedom from infringement of patents. The American Society of Municipal Improvements has not yet attacked the question, tho a committee has been at work upon it for some years. A report from the committee is expected at the Boston convention of October 6-9.

Plants Making Fertilizer from Garbage

Will you have the kindness to give me your opinion regarding the —— company's system of treating city garbage. Their system's purpose is to obtain from the garbage all the commercial products that can be derived from it. Have you written anything in MUNICIPAL ENGINEERING regarding this matter? If so, kindly let me know what numbers. Do you know of any cities that have this system in practice? Do you consider it the best?

E., ———, Costa Rica.

The tankage from garbage reduction plants is used as fertilizer. These plants are individually designed, using machinery more or less standardized by such makers and designers as the American Extractor Co., Providence, R. I.; American Process Co., New York; American Reduction Co., Pittsburg, Pa.; C. O. Bartlett & Snow Co., Cleveland, O.; Edson Reduction Machinery Co., Cleveland, O.; Kutztown Foundry and Machine Co., Philadelphia, Pa.; Penna Construction Co., Marietta, Pa.; Sanitary Product Co., Philadelphia, Pa.; Buffalo Foundry and Machine Co., Buffalo, N. Y.; V. D. Anderson Co., Cleveland, O.; F. D. Cummer & Son, Cleveland, O.; Ruggles-Coles Engineering Co., New York.

Dr. J. M. Hirsh, Chicago, Ill., is developing a chemical method of treating garbage, which will produce a fertilizer. His process was described in MUNICIPAL ENGINEERING for August, vol. xlvii, p. 131.

Methods of Collection and Disposal of Garbage

Will you kindly inform me whether there is anywhere to be obtained a reasonably full statement of the practices of the various cities of the Union in regard to the collection and disposal of garbage? I answered for Mobile a set of questions sent to me by one of the engineering publications, I thought it was yours, some months ago, but have never seen any mention anywhere of any compilation of the facts.

It is my belief that this city stands at the head in its handling of this problem, as it takes up not only all garbage, but all waste, including ashes, trimmings, tin and other debris daily, save in a very limited outside area, where it is taken up three times a week, and all without charge to the citizens.

HARRY PILLANS,
Commissioner of Streets and Public Works,
Mobile, Ala.

Statistics as to methods of garbage collection and disposal were collected by MUNICIPAL ENGINEERING some time ago but were so unsatisfactory that they have never been published, being almost wholly excellent descriptions of how not to do it. Several articles were written to show the principles which should be followed

and will be found under appropriate titles in MUNICIPAL ENGINEERING, vol. xl, p. 106; vol. xxxix, p. 286; vol. xlii, p. 183.

Some details of methods of collection and disposal in various cities, about 50 in number, will be found in articles in vol. xl, pp. 348, 445; xxxix, pp. 275, 286; xxxv, p. 8; xxx, p. 34; xxviii, p. 393; xli, p. 61; xliii, p. 327; xlii, p. 385 in Ohio cities.

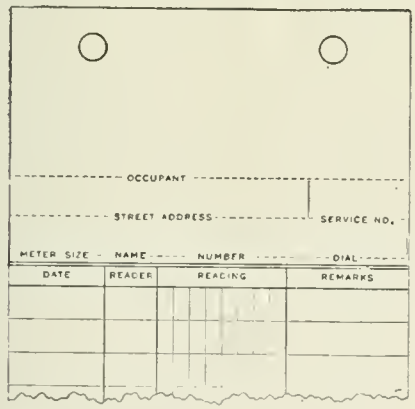
A classified list of articles on the various phases of the problems of garbage and refuse collection and disposal in many cities is given in vol. xlii, p. 252.

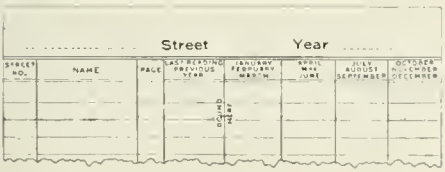
Meter Reading Records.

The writer is in the market for some meter reading records such as used by water companies. W., ———, Pa.

Accompanying are reproductions of headings of two forms of meter reading records which can be supplied by the Buffalo Meter Co., of Buffalo, N. Y. One shows a removable slip, two or three hundred of which are carried in a holder of aluminum, leather or board, which can be arranged in the order of the reader's route and removed for transcribing in the office books. The other shows two pages forming the double page of a pocket meter-reading book, of 100 double pages of 20 lines each, so that one book will hold the quarterly readings for a year of 2,000 meters. This book is bound in stiff drab canvas with flap.

The American Water Works Bookkeeping System, published by Engineering Publishing Co., Indianapolis, Ind., contains the best meter account book, to which the readings recorded in these pocket meter reading books or slips can be transferred and the customers' accounts kept conveniently and in proper form.





Who Designs Park Fountains?

A local organization of women has a fund of thirteen hundred dollars for the erection of a fountain in our city park which is at present being built. Can you advise us how best to secure plans and designs for the same?
Y., ———, Mont.

Will our readers refer us to any architects or sculptors who would make the design desired?

Designs in cast or wrought iron and stone, not always the most artistic and not distinctively individual, can be purchased of such manufacturing firms as F. P. Smith Wire and Iron Works, Chicago, Ill.; Stewart Iron Works Co., Covington, Ky.; J. L. Mott Iron Works, New York City.

Repainting Leveling Rod

I want to get made a stencil plate that will fit one foot of my Philadelphia leveling rod. Some of the figures and division marks on it have become indistinct by use.
B., ———, Mo.

The makers of leveling rods can make such stencils as are desired. It may be that it would be less expensive to send the rod to the instrument makers to be repainted than to buy the stencil, and it would also be more satisfactory. Manufacturers nearest our correspondent are Chicago Steel Tape Co., 6229 Cottage Grove avenue, Chicago, Ill.; A. S. Aloe Co., 513 Olive street, St. Louis, Mo.; Eugene Dietzgen Co., Chicago, Ill. W. & L. E. Gurley, Troy, N. Y., can do the work or supply the stencil.

Information About Management of Municipal Cemetery

Could you direct us to a house, firm, publication or book, from whom we could procure information relative to the business management of a cemetery? What we would like is sample ordinances governing cemeteries, cemetery record books, burial permits, deeds to lots and lot registers and everything pertaining to the business management of a municipal cemetery.
G., Mayor, ———, Wyo.

Will our readers give references to sources of the information desired, for the benefit of our correspondent? *Park and Cemetery* is a monthly published at Chicago which can probably supply the material desired.

WORKERS IN THE FIELD

Burned Asphalt Cement Can Be Prevented

The Editor of MUNICIPAL ENGINEERING:

Sir—I have read the article in your September number on "Burned Asphalt Quite Unnecessary," written by Mr. Geo. C. Warren, and in which he quotes Mr. Hetherington.

Mr. Warren commences by statiug that "apparently the article in the July issue was written by some one interested in the building of asphalt paving plants of a special type providing for steam heating the asphalt cement," and then writes a long treatise on different methods of constructing furnace heated kettles in a manner which he himself admits is very unsatisfactory, as should the asphalt cement become too hot "it is necessary to shut down the dryer fire, which cannot be shut off without closing down the entire plant." He consequently admits that it is possible to overheat a furnace-heated kettle (see ninth line, fifth paragraph), so we agree on this point.

Mr. Hetherington states: "But the real question is this: can you obtain 350 degrees F. of temperature from steam at 125 pounds pressure?" The statement was that "the asphalt cannot exceed 350 degrees F." His argument, however, substantiates the statement that by the use of steam heat the asphalt cannot be overheated.

Mr. Warren then classifies the statement, "'With furnace heat applied to the exterior of the kettle at a temperature of at least 1200 degrees F.' the asphalt cement is necessarily burned," as absolute "buncombe," and then goes on to give a steam boiler as an example. Just how he reasons that asphalt will conduct the heat away as rapidly as water I cannot understand. Asphalt is a very poor conductor and would prove disastrous to any boiler crown sheet as a consequence. However, if 1200 degrees F. is all "buncombe," then let me ask Mr. Warren what burns the bottoms of furnace-heated kettles when, as he admits, "an abnormal coating of sediment and coke (where did the coke come from if no burning took place?) has been allowed to collect?" I have seen numbers of kettle bottoms "bagged" (due to carelessness), in which case the steel has been sufficiently hot to allow it to bag down as much as four inches. Will you allow, say, 1800 degrees F. for this, Mr. Warren? In other cases I have seen them not only bagged, but burned to a blister, so that the least little tap with a hammer would go through. Shall we allow at least 1800 degrees F. for that also? This was also due to carelessness.

This talk about brick arches and other forms of protection sounds all right, but, in practice, the brick work generally gets shaken down in transit thru freight yards and frequently stays down, and if the average plant foreman has the same ideas as to asphalt and water conducting heat as Mr. Warren has, he ought not to be criticised for following an authority of some thirty years' experience, even altho the said authority happens to be mistaken.

Mr. Warren's admissions that asphalt can be overheated in a furnace-heated kettle if the operator is careless, and that an abnormal sediment of coke can collect, simply bears out statements made in the article in your July issue. Mr. Hetherington's statements that 350 degrees F. cannot be obtained from 125 pounds steam pressure still further emphasizes the safety of using steam heat and the impossibility of a careless night man burning the asphalt cement.

Mr. Warren quotes pavements that have not had the A. C. burned by furnace heat, but he does not quote those in the United States that have had. If steam heat had been used on all of them, there would not have been a single instance of a street having been laid with burned asphalt cement. Mr. Warren claims to have had thirty years' experience in the handling of refined asphalts. The writer has not only had a number of years' experience in handling refined asphalts, but has also refined asphalt. It would be interesting to hear from Mr. Warren just what is taking place in a perfectly clean kettle,

where, as he says, the kettle bottom "is never more than 20 degrees F. hotter than the asphalt cement at top of the kettle," but which, in spite of his assertions, forms bubbles, which, upon reaching the surface, burst and liberate heavy yellowish gray smoke. What is Mr. Warren's explanation of this phenomena? Also, what causes so much free carbon in some of the oils which have been treated with 1200 degrees F., as some of them are?

If Mr. Hetherington and Mr. Warren will stick to what is written and not inject theoretical interpretations, with a lengthy discussion of the same, we shall no doubt in time all arrive at the conclusion that a furnace that is capable of burning up the steel bottom of an asphalt kettle is also capable of burning the asphalt in the kettle, and by further experience Mr. Warren may discover that the conductivity of asphalt and water is entirely different. He will also discover, if he makes inquiries, that there are no railroad asphalt plants on which it is necessary to "shut down the dryer fire" to cool of the A. C. kettles.

By way of proving up their contentions I will defy both Mr. Warren and Mr. Hetherington to operate their automobiles after the engine water jackets, radiators, etc., have been filled with asphalt instead of water. They should be able to do this if, as they would lead one to infer, a steam boiler is the same as an asphalt kettle, and, if which is true, the absorption of heat in a given time is the same in both cases. SUBSCRIBER.

Trigonometric Tables of Grads

The Editor of MUNICIPAL ENGINEERING:

Sir—If your inquirer signing his name as L., ———, Conn., p. 215, September issue of MUNICIPAL ENGINEERING, will write to the undersigned, I can furnish him with a set of F. G. Gauss' *Four-place* Logarithmic Trigonometric Tables, *Decimal System;* that is, 100 degrees to the quadrant, 100 minutes to a degree and 100 seconds to a minute. The tables do not give "naturals," but they give, for the whole quadrant, the logarithmic sines, cosines, tangents and cotangents, for each degree to every 10 minutes and with proportional parts for quick interpolation. Also, the constants for Pi in its varied uses, the length of the radius in degrees of arc, and full instructions, in German, for the use of the tables. The tables I have are absolutely new, never used, and were imported by the writer some years ago from Berlin, Germany. I have likewise the four-place ordinary trigonometric tables by the same author, which were imported from Berlin at the same time, all new, but only two or three sets of each kind can be furnished. The inquirer must write me at once if he wishes to secure a set of these tables.

L. C. HJORTH,
Meadowdale, Wash.

Regulating Growth of Organic Matter in Reservoirs

The Editor of MUNICIPAL ENGINEERING:

Sir—Your August issue contains a very interesting abstract of a paper presented before the Franklin Institute by Prof. W. P. Mason. This article, and the one in which it is abstracted, are of special interest to me as showing that the copper sulphate process for destroying algae is treated as a standard method of sanitary practice.

In quoting a table from an article of mine, Professor Mason has made the same error which was made in abstracting this paper for "Wasser und Abwasser." I refer to the list of algae headed "Number of Observed Cases." In the original this table is given under the heading, "Showing the Occurrence of Genera, etc." I had used "occurrence" in the sense of "geographical distribution" in this table, and that fact is, unfortunately, not brought out by the quotation in Professor Mason's article. It was my intention to show the variation in the geographical distribution of the organisms most frequently reported as troublesome, and an organism is not listed as present in a state unless it has been frequently reported. KARL F. KELLERMAN,

Physiologist in Charge, Bureau of Plant Industry, U. S. Department of Agriculture, Washington, D. C.

The table referred to reads as follows in the abstract referred to:

TABLE II—SHOWING OCCURRENCE OF TWELVE GENERA OF ALGAE MOST FREQUENTLY REPORTED AS CAUSING TROUBLE IN RESERVOIRS AND PONDS.

	No. of cases.
Anabaena	27
Asterionella	9
Beggiatoa	20
Chara	26
Cladophora	17
Clathrocystis	23
Conferva	56
Crenothrix	13
Fragilaria	19
Navicula	21
Oscillatoria	49
Spirogyra	43

The table in the original paper is as follows:

TABLE SHOWING THE OCCURRENCE BY STATES OF GENERA OF ALGAE MOST FREQUENTLY REPORTED AS CAUSING TROUBLE IN RESERVOIRS AND PONDS

	Anabaena	Beggiatoa	Asterionella	Chara	Cladophora	Clathrocystis	Conferva	Crenothrix	Fragillaria	Navicula	Oscillatoria	Spirogyra
Arkansas	—	—	—	—	Y	—	—	—	Y	Y	—	—
California	Y	Y	—	—	Y	Y	Y	—	Y	Y	Y	Y
Colorado	—	—	Y	Y	—	—	Y	—	—	—	Y	Y
Connecticut	Y	—	Y	—	—	Y	Y	Y	—	—	Y	Y
Dist. of Columbia	—	—	—	—	—	—	Y	—	—	—	Y	—
Georgia	—	—	—	Y	—	—	—	—	—	—	—	—
Idaho	—	—	—	—	—	—	—	Y	Y	—	Y	Y
Illinois	—	—	—	—	Y	Y	Y	Y	—	Y	Y	Y
Indiana	—	Y	Y	—	—	—	Y	—	—	—	Y	Y
Kansas	—	—	—	—	—	—	Y	—	—	Y	Y	Y
Kentucky	Y	Y	—	—	Y	Y	Y	Y	—	—	Y	Y
Louisiana	—	—	—	—	—	—	Y	—	—	—	—	Y
Maine	—	—	Y	Y	—	—	—	—	—	—	—	—
Maryland	Y	—	—	—	—	—	—	—	—	Y	Y	Y
Massachusetts	—	Y	—	Y	Y	Y	Y	—	Y	—	Y	Y
Michigan	Y	—	—	Y	—	Y	—	—	—	Y	—	—
Missouri	Y	—	—	Y	Y	Y	Y	Y	Y	Y	Y	Y
Minnesota	—	Y	—	—	Y	Y	—	Y	—	—	Y	—
Montana	Y	—	—	—	—	—	—	—	—	—	Y	—
Nebraska	—	—	—	—	—	Y	—	—	—	Y	—	Y
New Hampshire	—	Y	Y	—	—	—	—	Y	—	—	—	—
New Jersey	Y	Y	—	Y	Y	Y	Y	—	Y	—	Y	Y
New Mexico	—	—	—	Y	—	—	—	—	—	—	Y	—
New York	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Ohio	—	Y	—	Y	Y	—	Y	—	—	Y	Y	Y
Oklahoma	—	—	—	—	—	—	Y	—	—	Y	—	—
Pennsylvania	Y	Y	Y	Y	—	—	Y	—	Y	Y	Y	Y
Rhode Island	—	—	—	—	—	Y	—	—	—	—	—	—
South Carolina	—	—	—	—	—	—	Y	—	—	—	—	—
South Dakota	—	—	—	—	—	—	Y	—	—	Y	Y	Y
Tennessee	—	—	—	Y	—	—	—	—	—	—	—	—
Texas	—	—	—	Y	—	—	Y	—	—	Y	Y	Y
Vermont	—	—	—	—	—	—	—	—	—	Y	Y	Y
Virginia	—	Y	—	—	—	—	Y	Y	Y	Y	—	Y
Washington	—	—	—	—	—	—	—	—	—	—	Y	Y
West Virginia	—	—	—	—	—	—	—	—	—	—	—	Y
Wisconsin	—	—	—	—	Y	—	Y	Y	Y	Y	Y	Y

How to Do Business in Latin-American States

The Editor of MUNICIPAL ENGINEERING:

Sir—I have been making Latin America rather a study for some time, realizing that the ultimate interest of the United States would turn in that direction. The present European conflict has done more in a month to advance this interest than the ordinary course of events could have done in many years.

The trouble has been, in detail, that American merchants and the public here have never realized to what extent our Latin American neighbors have advanced. Rio de Janeiro, probably one of the most beautiful cities in the world, and one of the most modern in a quiet, dignified way, is thought of generally as a little tropical town, and not one person in ten (or even a hundred) has any idea of the size or importance of Buenos Ayres.

Thru ignorance and the underestimation of the South American markets, our merchants have only gone after the trade in the most desultory fashion. Salesmen have been sent who spoke only English and who rushed in with "Yankee" haste, trying to force an order from the customer with only one interview. This method of his does not appeal to the Latin American merchants, who make friends first and talk business afterwards. American catalogs have frequently been sent in English, and American goods, when the orders are secured, have generally been badly and wrongly packed.

Germany, however, has avoided these and many mistakes, and above all has realized the value of South American trade, hence the strong hold she has secured in every South American city.

C., New York City.

ROADS AND PAVEMENTS

Putting Paving on a Systematic Basis in New Orleans

New Orleans has just begun work under a new paving law which represents improvement and progress toward the systematizing of city paving work. The essential features of the law are that prior to the first of September the city must make its plans for all the street paving that is to be done during the succeeding calendar year; after the bids are opened they are published for a month and the property owners are given an opportunity to petition for the type of pavement that they desire. Thereafter certificates are sold against the assessments for the work and the proceeds of the sale of the certificates are used to pay the contractors.

The assessment proceedings are to be finished before the beginning of the work, thus financing the property owners' portion and doing away with the troublesome tax lien. The bonds sold in anticipation of the collection of the property owners' share of cost rest not only for their security on the fund created by the assessment, but are made by law an obligation of the city and given a specific lien against the city's reserve funds. They may be sold as low as 95, thus facilitating their prompt disposal at times when the bond market is below normal. This amounts to making up in advance a plan covering the amount of paving to be done and types of pavements to be laid, as well as the financing of a year's work.

It is provided that bids are to be taken on a great many types of pavements, for which detailed specifications are legalized. These specifications include sheet asphalt, asphaltic concrete, cement concrete, rock asphalt, mineral rubber and wood block. The bituminous specifications draw a clear distinction between "oil manufactured asphalt street pavement" and "natural pitch asphalt street pavement"; but full competition is provided between all these different types without making the attempt to cover all or any general class of materials or pavements in any one specification. No specifications are "closed," except those describing patented pavements. At the same time this law provides active competition and yet makes a distinction between products of different characteristics and varying prices, experience having shown that when blanket specifications that cover everything are attempted the city merely makes it certain that it will get the cheapest material without regard to relative values.

Repairing Concrete Pavements

In a recent paper Frank F. Rogers gives some information about the repair of concrete pavements and roads, from which the following is taken:

The oldest concrete pavement of which the writer has knowledge was built at Bellefontaine, O., in 1893 and 1894. On December 14, 1912, Mr. C. A. Inskeep, city engineer, wrote me that the approximate total cost for repairs had been $200 on 4,400 square yards. When laid the pavement was cut into squares, and the principal part of the wear has been along the longitudinal joints thus formed. Repairs have usually been made with cement mortar or concrete, which has been placed in the grooves after they have been chiseled out. Sometimes this patch has been dovetailed in—that is, the sides of the notch incline towards the axis of the groove rather than outwards. In some places paving bricks, laid crosswise, have been cemented into the prepared notch, instead of making the entire patch of concrete. This has been done when it was impracticable to keep traffic off the street long enough for a concrete patch to harden. If the reported figures are accurate, the total repair cost has been only 4.77c per square yard in eighteen years, or 0.265c per square yard per year —a repair cost which seems almost incredible.

Bad Axe, Mich., a town of 2,500 population, paved its main street with cement concrete in 1908, with gravel concrete two-course work. The contractor guaran-

teed this street for five years, and has patched a few places, by chiseling out the old pavement to the subgrade and filling the excavation with two-course concrete of the same mix used in the original construction. The transverse joints now show considerable wear, the groove, due to chipping off the edges of the adjoining slabs being, in many places, two inches deep, and very perceptible when riding over the pavement in an iron tired vehicle even at a slow speed. Similar wear is visible around the edges of some of the patches. There are also some holes which need repairing.

The pavements at Grand Ledge and Scottville were laid in 1910. Both were two-course work and were in need of some repairs the second year, mostly at the joints.

The pavements at Ann Arbor and Lansing were top dressed with tar and sand, refined tar being used on all the later work. This top dressing wears off annually, particularly in the central portion of the roadway, and has to be wholly or partially renewed at a cost of from 5 cents to 6 cents per square yard.

Kalamazoo, Mich., carefully watches the surface and all holes are repaired when they are small. The holes have been thoroly cleaned, washed with cement and filled with a 3 to 1 mixture of good bank gravel and portland cement. These repairs have given good results. The pavement shows a large number of long surface cracks with the edges wearing rapidly. The percentage of surface repaired during the first five years of life is small, but a larger percentage will have to be repaired in the next five years. Saginaw county, Mich., built its concrete road in 1910, and it has had quite extensive repairs. The portions that have been found defective were due to a leaner mix or to a less depth than was specified. Repairs have been made by cutting out the defective places to the corrected subgrade and filling with concrete. This pavement carries a rather heavy mixed traffic, consisting of heavily loaded farm and trucking wagons thruout the season, and a heavy sugar-beet traffic (loads, 2 to 5 tons) during the months of October and November on a 9-foot width. Repairs have been very small on the better built portions of this road.

On November 23, last, an inspection was made of the Woodward avenue concrete roadway, one mile of which was laid previous to July 1, 1909, and 1 1/5 miles of which was laid in the early part of the season of 1910. Both of these pieces are the two-course work above referred to. These pavements are 18 feet wide and have transverse expansion joints every 25 feet, making 211 sections to the mile. The oldest mile has had nearly four seasons' wear and has passed thru three winters. On the first mile, 9 sections show one or more pit holes, 17 sections show transverse cracks, a very few of which reach entirely across the roadway, and 61 sections show longitudinal cracks, many of which reach the whole length of the section. In fact, most of these longitudinal cracks are grouped, several contiguous sections showing cracks where there were any at all. Isolated sections showing longitudinal cracks are the exception and not the rule.

The 1 1/5 mile stretch, which has had nearly three seasons' wear and has passed thru two winters, shows defects as follows: Pit holes, 8 sections; transverse cracks, 7 sections, and longitudinal cracks, 13 sections. For better comparison, I will say that 29 per. cent. of the sections showed longitudinal cracks on the first mile, while only 5 per cent. of the sections showed longitudinal cracks on the second 1 1/5 miles. Roads of more recent construction show proportionately less defects.

Laying Concrete Pavement

The Highway Commissioners of Wayne County, Michigan, have been laying concrete roadways with their own equipment, labor and supervision long enough to reduce their methods to a system which secures increasingly better results. A brief description of the principal steps in the process may lead to further study of the details of the process whereby quality of work is maintained and cost is kept low.

When the road to be improved is crossed by or is near a railroad, and switching and yard facilities can be obtained, the cars of gravel, sand, cement, etc., are unloaded in piles as they are received, the piles being located conveniently for reloading into cars, and cement being stored in a waterproof closed shed.

The commissioners own the equipment for an industrial railway with several miles of track and the first operation after the construction of a road is decided upon is the laying of this track alongside the location of the concrete roadway, the ease of changing location being such that but little grading is necessary beyond that required to give the roadway its proper gradients and foundation.

A small industrial locomotive is used to transfer cars and occasional turnouts at convenient locations make it possible for loaded trains to pass empty cars hauled by team or by men. These cars are first used in transferring earth moved in grading the roadway from cut to fill or to waste and when the work is well under way in all its stages the locomotive is kept busy hauling cars of earth and cars

of concrete material and returning empty cars.

The industrial railroad begins at the stock piles and the cars can be filled by hand or steam shovel, according to the amount of work to be done and the rapidity with which the materials are to be moved.

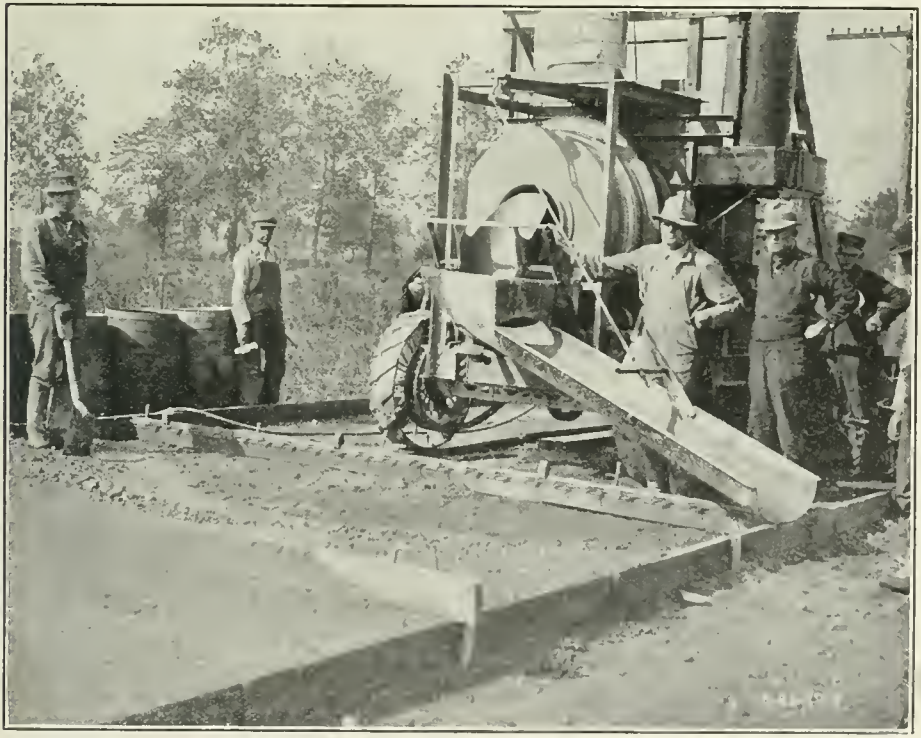
When the sub-grade of a section of the road has been properly formed and consolidated, as the local circumstances demand, the concrete mixer is set to work, a Chicago concrete mixer being shown at work in one of the accompanying photographs. That photograph shows plank form staked down, to retain the concrete until set, but the Wayne County Commissioners are using an improvement on the forms, made by the Trussed Concrete Steel Co., in the shape of a steel form made of channel bars, staked down with bent rods as shown in the second photograph.

These channel bars are jointed together by bars fitting in slots made by riveting steel strips to the webs of the channels, as shown in the photographs, and are therefore continuous at the same time that the individual bars are easily removable as soon as the concrete has set, and can then be carried forward to extend the forms. There is flexibility enough in the system of bars to make their alinement easy and certain, and stiffness enough, when they are staked down, to withstand the pressure of the concrete while being placed. Concrete is deposited wet enough so that it requires no tamping.

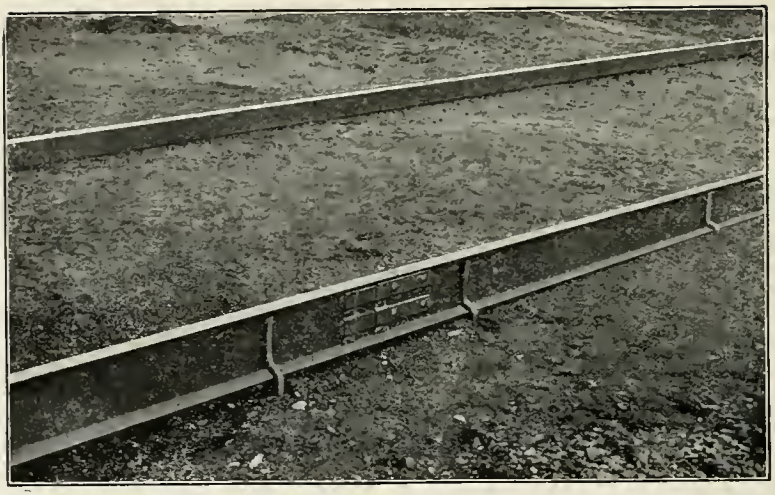
The concrete mixer is self-propelling, and, when a section of the road reachable by the trough or telescoping tube used in distributing the concrete has been covered, it moves itself forward a few feet on planks laid for the wheels to run upon.

The preparation and placing of the expansion joints is an interesting operation. On one road, whose construction was observed by the writer, the protecting plates were thin, soft steel plates with short parallel slits cut in them in pairs a few inches apart, devised by the Trussed Concrete Steel Co. These plates were delivered along the road together with the strips of compressible asphalted felt filler.

One man prepared these joint protectors for the use of the concreting gang. Laying a plate flat on the ground, he broke one end of each strip between slits free from the plate by blows with a pick of the right width to fit the resulting slot.



LAYING CONCRETE PAVEMENT *in Wayne County, Michigan. Placing expansion joints and laying and surfacing concrete. Wooden forms used.*



LAYING CONCRETE PAVEMENTS *in Wayne County, Michigan. Modern steel continuous forms movable in sections.*

Turning the plate over, he first bent the tongues thus formed back, and then with a bar having a notch of the right size, bent and twisted the tongue so that it projected at right angles to the plate and had a quarter turn of a twist in it. Two of these plates being prepared, they were put together, back to back, with the strips of asphalted felt between them, and they are then clamped together by means of a frame with a number of short rods fitted with eccentrically mounted circular cams which, when turned, grip the plates firmly along the upper edge. The plates are curved to fit the crown of the roadway and when thus held together are ready for placing in position for the concreting, as shown in the first of the accompanying photographs. The frame spoken of is somewhat stiffer and more elaborate than the simple clamps seen in the photograph and the placing and keeping in place of the joint protector is more accurate and certain. The clamps are loosened and the clamps and frame are removed as the concrete is laid on the farther side of the joint. The plates of the joint protector are carefully placed so that their top edges are a small fraction of an inch below the level of the finished concrete and can then be depended upon to wear evenly with the concrete, and thus prevent the formation of breaks or holes alongside themselves.

After the concrete is set sufficiently it is covered with sand or earth, which should be kept moist until the concrete has been thoroly cured.

Usually water is supplied along the work for moistening the foundation just ahead of the concrete, for the mixer and for wetting the covering of the concrete, by means of a pipe laid alongside the road from a convenient source of water supply, thru which it is pumped by a gasoline pump at pressure sufficient for the uses made of it. Sometimes several thousand feet of the water pipe are in use at once, but usually a few hundred feet are all that are necessary.

Slag For Road Paving

In London experiments have been made in the use of tar slag macadam in several streets, and the following is a report of the results as observed thus far:

In St. Marylebone the material was laid in two coats and rolled, the surface being covered with fine granite chippings, and the total thickness when finished being 4½ inches. The price varied from 4s. to 4s. 8d. ($1 to $1.15) per yard super, and the paving is said to be wearing well.

The New Eltham and Sidcup road, trial length, was laid down in July, 1911, by the Kent County Council by arrangement with the road board. The material used was blast furnace slag ranging from 2¼ inches down to ¾ of an inch. When laid in one coat of mixed gages, the proportions are about 60 per cent. ranging from 2¼ inches down to 1¼ inches, 30 per cent. from 1¼ inches down to ¾ inch, 10 per cent. from ¾ inch down to ½ inch. The binder used is distilled tar, without any admixture of other material, and after first setting it is not affected by normal changes of temperature. The cost per yard super. was 3s. 3d. as paid to contractors, and the paving has stood well and is said to be satisfac-

tory. Another section, 794½ super. yards, on the same road, laid with the same material, is also satisfactorily reported upon. The road board says:

"This section is quite good, and shows comparatively little wear. The roadway on both sides of this section is properly curbed and channeled, and has properly constructed footpaths. These abutments give considerable support to the material forming the carriageway, preventing lateral thrust, and enabling better initial consolidation."

In the boro of Wandsworth, on the Portsmouth road, trial lengths were laid for the express purpose of making comparisons between the rates of wear of previously treated tarred granite when compared with similarly treated tarred slag macadam. A section of the latter—1,629.16 super. yards—was completed in August, 1911, coated slag being spread in two layers, first layer graded from 2½ inches down to 1½ inches., second layer from 1½ inches to ½ inch, surface finished with fine chippings. The cost per yard super. was 4s. ($1). The condition of this section is said to be good, and the surface wearing uniformly.

The New York State Highway Commission last year laid some sample slag pavements, some report of which is made by Division Engineer F. S. Strong in the official organ of the commission, from which the following is derived:

The types in which the use of slag is allowed include plain concrete pavements, concrete pavements with bituminous surfacing, Hassam concrete pavements, water-bound slag macadam with and without glutrin, some with limestone screenings and some with slag screenings, and bituminous-bound slag macadam highways. Much of this work is now under contract, and a considerable portion of it will be completed this year. The material is also being used to some little extent as a surfacing material in the repairing of old macadam pavements.

It is believed that the careful and continuous future inspection of the highways built of slag will produce valuable information and statistics of its merits as a road metal.

A big bulk of the slag available in the section of the state referred to consists of blast furnace slag. However, in the further reduction of pig iron in the production of steel, various processes are used, as, for instance, in the open-hearth furnace, where the crude metal is further purified, here again a flux is used which rises to the surface of the molten mass as slag. Slag formed in this operation has been used but very little on account of the small qnantities available for highway purposes, altho it possesses many desirable qualities, such as hardness, toughness and excellent cementing qualities.

In the vicinity of Youngstown, Ohio, in 1909, the office of public roads, in cooperation with the Carnegie Steel Company, conducted a series of experiments to determine the best method of utilizing this slag for road construction. In the experiments at this place, the blast furnace slag was taken from a bank that had aged about two years, the material of which came from six blast furnaces of the same type. A stea mshovel was used to load the slag from the bank into large gondola cars. These cars were drawn to a gravity screen, where the slag was dumped into a chute and passed over the screen to separate into proper sizes. After passing over this screen, it was taken by rail to a site about 1½ miles from the road upon which it was to be used, unloaded and hauled to the road.

These experiments, as shown by the bulletins issued by the office of public roads, proved very interesting, and demonstrate that there is a field for blast furnace slag in the construction of highways, and the results were so favorable that the various counties and the State Highway Department of Ohio have adopted standard specifications for the use of this material. Various reports of inspections made of these roads show that they have stood up well, and, owing to the cheapness in the first cost of this material and the lightness in weight, the investment in a slag furnace macadam pavement from an economic standpoint would seem to compare favorably with that of a stone macadam pavement.

Since the completion of these experiments, which were conducted with slag which was not run thru a crusher, but was taken directly from bank and screened, slag pavements have been constructed from commercial blast furnace slag, the slag being carefully sorted to obtain the best materials and run thru a regular stone crusher in order to obtain the proper sizes for use in the various courses of macadam, resulting in superior types of construction and more uniform and lasting types of pavements.

In the vicinity of Buffalo, where there are many large blast furnaces, this slag has been used to some little extent for highway work, altho no intelligent effort was made to obtain a high-class construction, due to the lack of available money for said purposes in the localities where the work was done. Yet this material is found to consolidate under traffic without rolling, harden and smooth out, making an excellent country road. Where inclsions were made in some of these roads for various purposes, it was found almost as difficult to cut thru this material as to

cut thru a concrete foundation for brick pavement.

At the beginning of 1913 a plant was established in connection with the Buffalo Union Iron Furnace to take over the slag product of these blast furnaces and produce therefrom a commercial product to be known as crushed screened slag for railroad ballasting and highway surfacing purposes. During the season of 1913 a considerable amount of this material was used on town highways, and reports received from various town and county superintendents in districts where this material was used stated that satisfactory results were obtained, altho thus far it is too early to reach any conclusion as to the definite wearing qualities of this material.

In reference to the use of slag product in the open-hearth process in the manufacture of steel, perhaps some of the most successful work of this kind in the construction of streets or highways is that which has been done in the city of Cortland. In this city the first slag street was constructed ten years ago as a water-bound macadam highway, and, according to the city authorities, has given excellent results ever since. They also have other water-bound slag roads which have been built eight years with practically no repairs of any nature. During the last four or five years the city authorities have used a bituminous or asphaltic binder in the construction of the slag streets, using the penetration method with excellent results. The slag after being cooled is crushed in an ordinary stone crusher, the larger pieces being used in the bottom course, which is bound with loam. For the body of the top course, a slag varying in sizes from ¾ inch up to 2 inches is used. This top course has a finished depth of 3 inches, and is bound with a gallon to a gallon and a half of asphaltic binder to the square yard; is then filled with slag screenings and rolled. These streets have also the appearance of sheet asphalt pavements and are standing up well under fairly heavy traffic.

Calcium Chloride in Road Maintenance.

The use of deliquescent salts in maintaining road surfaces has been studied very thoroly by S. G. Howe, of Detroit, Mich., and he has devised methods of using them for various materials and classes of traffic which produce the best results attainable, and suitable for conditions too strenuous for the ordinary earth or gravel road and not heavy enough to demand expensive hard or pavement surfaces.

One method offered is the use of "rubber-stone," a mixture of fine crushed stone material with deliquescent salts, chlorides of calcium and magnesium, a 40 per cent. solution of the chemicals being used in making the mixture.

According to Mr. Howe, rubber-stone is or may be made of a cheap, soft stone, either sand or limestone, a soft, porous stone acting as a carrier and retainer of the chemical; also a low-grade clay containing gravel, as well as properly crushed soft slag or clean steam furnace cinders. All of these substances are cheap, many of them in some parts of the country are a useless waste, so that, with a low-priced chemical to give the binder, the result is a cheap road material. There is hardly a county or township in the country which does not make or contain one of these substances within its borders, so that the expense of team or rail haul and freight rates ought to be light.

If the road dries out, which it is not likely to do very often, the condition is that of a stone macadam or concrete road, but if the rubber-stone is laid of proper thickness there is little likelihood of this condition. Even if the surface becomes dry, capillary action will bring moisture from below to maintain an even packed condition on the road.

In these combinations, the stone mixture should be from dust to three-fourths or one-inch size, the dust and fine stone being the carrier of the chemical, the coarser stone giving the body to the road. Coarser stone is better for a base, but for the surfacing material the coarser stone should be kept out. With gravel, the clay is the chemical carrier. For surfacing work, stone above 1½ inches in size should be screened or raked out and used as a filling for low or soft places in the road. For rut-patching, run of bank gravel may be used, the coarser stone acting as an anchor to the finer stuff. Where a slag is used, the conditions should be the same as with crushed stone; and here the finer stuff is used as a chemical carrier. With cinders it is not essential to crush the larger pieces, as the traffic over the road in the packing will generally reduce them enough. These materials are preferable in the order named, but a good road of this class may be made of any of them.

The essential requirements made by Mr. Howe are a proper quality and quantity of chemical thoroly incorporated; a proper thickness of the rubber-stone on the road top, preferably a 5-inch loose spread, which will pack to about four inches; a proper nursing or spreading of the material on the road as it is being packed, traffic not being shut off; keeping a man on the road with a rake or scraper to fill in the wheel marks until the road is hard and smooth; and proper drainage.

This chemical will not take or hold water enough to become muddy if the surplus water is allowed to run off, but good drainage is required on any kind of road or pavement if service is expected.

Any good, firm earth will answer for a foundation, low or soft spots being filled with cinders or stone of any kind.

Mr. Howe concedes "that the so-called scientific theories regarding these deliquescent salts have been against a long life for them under exposed conditions, but my five years of actual experience with them under very trying conditions have disproved all their theories." He shows 4½ years' success with gravel on a piece of road at Bloomfield Hills, near Pontiac, Mich., and the same with a piece of road at the Detroit Copper and Brass Works, where they haul 5-ton loads of copper over it every day, and it is apparently in as good condition today as when it was fixed up.

A cheaper construction simply grades the ordinary earth or sand road, loosens up 3 or 4 inches depth with disk harrow or spike-tooth drag, and fills the loosened earth with a 30 per cent. solution of Del. Q. salt. The sprinkling cart is set for half discharge and the road is given about four sprayings and mixings with harrow. About 6,000 gallons of the salt solution are required for 20,000 square yards of road surface.

For dust laying the road can be sprinkled with the salt solution at such intervals as may be required.

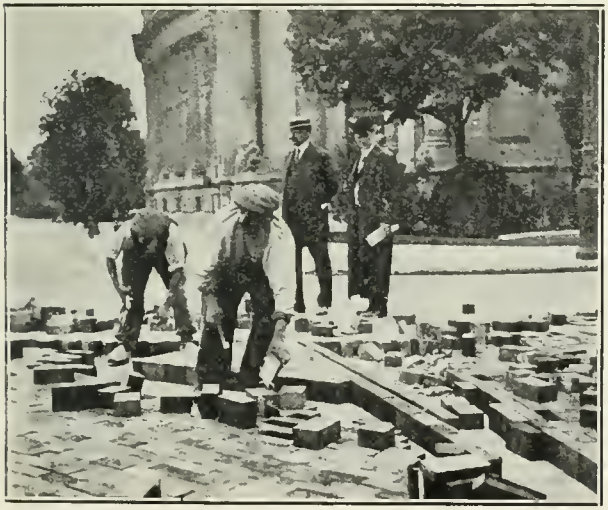
No adequate idea of the cost can be given without knowledge of the cost of the materials locally, but roughly speaking it may be said that the rubber-stone method will probably cost between 50 and 95 cents a square yard, the filled road 20 to 25 cents and the sprinkling 1½ to 2½ cents a square yard. One method of computing the cost of the dust-laying treatment of earth roads makes the cost 3 cents a foot front per year for the first three years, when the road will be in condition to skip the treatment for two years.

Mr. Howe is patenting his combinations and methods, but is very liberal in his permissions to use them provided he can insure success by supplying the chemicals required, on which success very largely depends.

Removal of Wood Block Troubles in Europe

In a recent paper describing his observations of wood block pavements in Europe, S. R. Church stated that European wood pavements do not bleed, expand or buckle, and are not slippery. He inquired briefly into the reasons to see what we have to learn from their methods. His conclusions follow:

Conditions are so entirely different that I do not see how any direct comparison can be made. In the first place, as to slipperiness, I have already explained that the non-slipperiness of their pavements is due to the use of softer wood. As to bleeding, they seldom have any weather in London hot enough to cause bleeding. In Paris there is not enough oil in the blocks to cause bleeding. The climate also undoubtedly plays a very important part in the question of expansion and contraction. It is agreed that the sudden expansion that sometimes takes place in our wood pavements is due to a rapid absorption of moisture, usually after the pavements have been unduly dry. This can hardly occur in England, where they have a little rain all the time, very seldom any torrential downpours or any long-continued dry spells. The average humidity is high. It is a question whether the pavements ever get dried out to anything like the extent that ours do. I should say that generally the blocks are in a maxi-



WOOD BLOCK PAVING IN PARIS. *Laying five-inch Swedish pine blocks on Cours la Reine, illustrating the expansion joint.*

PARIS WOOD BLOCK PAVING. *Applying cement and sand grout to surface of completed pavement in Cours la Reine.*

mum condition of expansion. The same must be true in Paris, or the inadequately treated blocks in that city would certainly bulge. On the other hand, it is well worth considering if the kind of wood that they use has something to do with the lack of expansion troubles. It is manifestly a very different wood from our long-leaf yellow pine. As I have already stated, it does not present as attractive an appearance, and it is probably not so durable. It may be, however, that with short-leaf pine or tamarack or Douglas fir we could obtain results more nearly approaching the European results by following their practice more closely with regard to treatment and methods of laying.

I believe we can afford to give careful consideration to the question of lighter treatment, but I do not believe that because ten or twelve pounds is ample in London with the wood they are using and the climate that exists, it would be ample for our woods in our climate.

The points that I would especially emphasize for your consideration are:

1. The great care used in the preparation of the concrete foundation, and, in fact, in the whole workmanship of the pavement.
2. The general use of deeper blocks.
3. The universal practice (in England) of sealing the joints of the pavement with coal tar pitch, so as to prevent the entrance of moisture.

I would also emphasize that the pavements in Europe (this does not apply only to wood) are laid and maintained by workmen who have more conscience, or at least take greater pride in their work than we find on the average job in our country. There is less inspection on the part of the city of the operations of making the blocks and laying them, but I got a very strong impression that the manufacturers are taking no chances of having their material condemned on account of carelessness or bad workmanship.

In conclusion I want to repeat that in my judgment none of the European wood paving surpasses our best wood streets in appearance.

Street Paving in Des Moines, Iowa

The total length of paved streets in Des Moines is 101 miles, divided as follows: Brick, 58 miles; asphalt, 34 miles; creosoted wood block 3 miles; concrete, 3.5 miles; bitulithic, 1.5 miles; macadam, etc., 1 mile.

The total area is 1,950,000 square yards.

The first pavements, laid in 1882, were the untreated round cedar blocks. These have long since been replaced by more durable material. Brick has always been favorably regarded, Des Moines being an important producer of this material. Asphalt has been extensively used for the last ten years, especially on residence streets. During the last year or two bitulithic has entered the competition against asphalt. Creosoted blocks have been considerably used on business streets. Concrete, altho hardly out of the experimental stage, is expected to prove valuable for residence streets and roads leading into the country.

Work on pavements has been especially active during the past four years. In that time the average per year has been nearly ten miles, of which about two miles each year was renewal of worn-out pavements.

The width of the roadways for business streets is made as great as the total width of the streets will permit, a 42-foot roadway being used for a 66-foot street. For residence streets with double track street railway the roadway is 34 to 36 feet; with one track, 30 feet; and with no track from 22 to 26 feet.

The City Railway Company pays for 7 feet width of pavement for each track, extending along paved streets, the remainder is assessed against abutting property, the limit of assessment being

25 per cent. of the assessed valuation of the property.

The present tendency in paving is to extend pavements on main highways to the city limits, there to meet improved roads built by the county. Two such streets have already been paved with brick, the city and property owners dividing the expense, and some preliminary work has been done toward paving several others with concrete.

Especial attention is now being given to the establishment of suitable street grades before paving. In a number of cases old grades have been materially changed, and new alinements worked out for crooked streets, with the idea that any temporary inconvenience occasioned by such changes are more than offset by future benefits resulting from improved traffic conditions.

Division of Roads For Traffic

By Francis Wood, Boro Engineer and Surveyor, Fulham, England.

With reference to the method of classification of roads, any census of traffic that is taken is usually divided by the width of the road, but a road may be very wide and the traffic confine itself to about 12 feet in the center of its width, this portion of the roadway wearing rapidly, whereas the remainder is scarcely affected. To divide the traffic on such a road over its full width would give a deceptive indication of the real unit of traffic per foot of width.' I therefore suggest that where there is only one line of traffic, whatever the width of the road, the effective width should be taken at 12 feet; where there are two lines of traffic, 20 feet should be the width, and with four lines of traffic, 30 feet should be the width, whatever the actual width may be.

Then the roads should be included or denominated, according to the unit of traffic, the horsed traffic being kept separate from the motor traffic:

Thus, if a road has 100 tons per foot width of roadway per day, made up of 30 tons heavy motor traffic, 20 tons light motor traffic, 25 tons 2-horse traffic and 25 tons 1-horse traffic, the road would come under the letters B-G-S-X, *i. e.*, Heavy and Light Motor Traffic Class II, and 2-horse and 1-horse Traffic Class III, and without trouble the comparison would easily be made with any other census of traffic.

Division of Roads for Traffic.—With reference to the laying out of new roads, the method of dividing the road up into three parts, the two side divisions being allocated to slow-moving traffic while the center one is confined to fast-moving traffic, has much to be said in its favor, but its applicability is confined to the design of new towns on account of the cost of land; there is also another feature which has to be considered, and that is the effect of such a road on the land adjoining it. A narrow road is considered to be advantageous to a shopping center, because the shops are brought into the view of the passenger traffic on both sides of the road, whereas the wide road has the opposite effect, *i. e.*, of confining the shops to one side of the road, and of rendering the other side derelict.

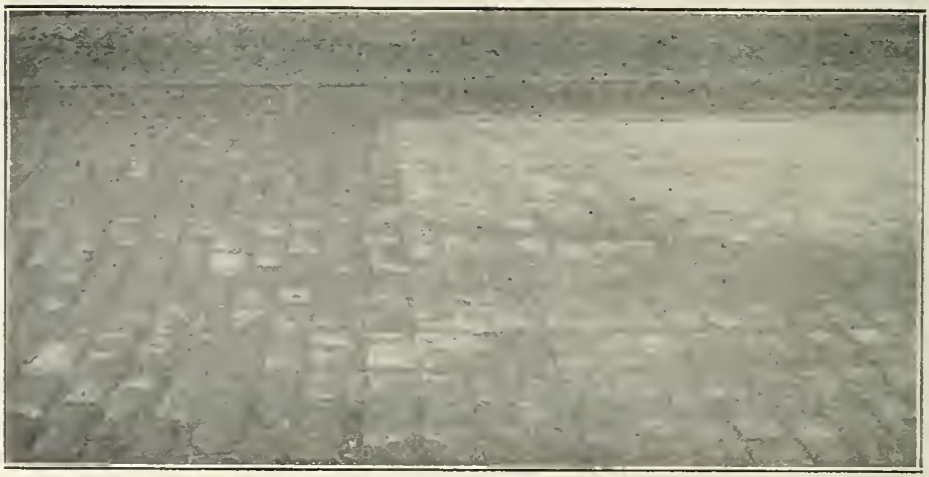
Duplicate Roads.—In this case it may prove to be a desirable method, instead of having very wide roads, to provide one or two parallel roads, and in this way divide the slow from the fast traffic. But to lay down definite lines is not a policy that should be advocated without careful inquiry into the requirements of the districts thru which the traffic passes, as in every town there may be peculiar difficulties which militate against such a proposal.

Subways at Dangerous Crossings.—Then there are the areas where traffic concentrates and makes it difficult for passengers to make a crossing. In many such cases it has been considered necessary to construct subways, but these subways are constructed so as to disturb in the least possible manner the existing

Class of Road	Motor Traffic		Horse Traffic		
	Heavy	Light	4-horse	2-horse	1-horse
	Tons per foot width	Tons per foot width	Tons per foot width	Tons per foot width	Tons per foot width
I.....	1 to 20 A	1 to 10 F	1 to 10 L	1 to 10 Q	1 to 10 V
II.....	20 to 40 B	10 to 20 G	10 to 20 M	10 to 20 R	10 to 20 W
III.....	40 to 60 C	20 to 30 H	20 to 30 N	20 to 30 S	20 to 30 X
IV.....	60 to 80 D	30 to 40 J	30 to 40 O	30 to 40 T	30 to 40 Y
V.....	80 to 100 E	40 to 50 K	40 to 50 P	40 to 50 U	40 to 50 Z

conditions, with the result that the subway, instead of being a benefit, has been a waste of money, as the public finds them inconvenient and difficult to use by reason of the steps down and up at the entrance and exit. Instead of being as shallow as possible, *i. e.*, below the surface of the road, they are placed very often at too great a distance below the surface. If a subway is necessary—a bridge is practically an impossibility on account of the height it must be over the roadway—then the public should be put to the least inconvenience possible, and encouraged to use the subway. The roadway would be effectively widened by the substitution of the subway for the surface crossing, and to narrow the actual width of the roadway would cause no great inconvenience to the vehicular traffic, therefore, this area could be added to the subway and footway. Where the subway has to be constructed, the writer suggests that if any inconvenience has to be caused to the traffic, it should be to the vehicular traffic rather than to the passenger traffic; naturally, however, some of the inconvenience must be given to the passenger traffic, but as their safety would be assured by the avoidance of danger, they would not complain.

The roadway should therefore be raised a proportion of the height that is necessary for the subway to be below the surface; with modern methods this would be probably confined to about 8 feet 6 inches, and, instead of slopes, an easy gradient should be made at the entrance and exit on either side. Suppose the buildings on either side of the street were 60 feet apart, and the subway extended 40 feet on either side, the total length of the subway would be 120 feet. The roadway could be increased in height 3 feet, and the subway would be 5 feet 6 inches below the original surface of the road, and the slopes for passengers could be at the rate of 1 in 16, or thereabouts. The footway would be 7 feet wide and about 5 feet would be given to the subway, this would leave a 36-foot roadway. Where the roads had already a slope there would be a difficulty in carrying out such a proposal, but doubtless a modification could be devised which would be an improvement on the present system. The cost of such a proposal would be very considerable, but having regard to the fact that the construction is of a permanent character, and is to be for the benefit of a great number of people, the cost may be regarded as somewhat of a secondary consideration, as it is impossible to calculate the value of the benefits which the public would derive from it.



DIFFERENCE BETWEEN *old granite block and modern dressed granite block pavement on Market street, Philadelphia, Pa.*

Recent Granite Block Pavements in Philadelphia

Market street in Philadelphia, was repaved in 1913 from the end of Schuylkill river bridge to Lancaster avenue. The traffic on the street is very heavy and it was paved with granite blocks which were very old and had worn until the pavement was very rough.

The street was repaved with the most modern type of dressed granite block pavement conforming to the best modern standards for this class of work. The new type of granite block forms a pavement almost as smooth and easily cleaned

as asphalt and yet sufficiently durable to withstand the wear of heavy traffic.

The new pavement has a 6-inch concrete base and a 2-inch sand cushion. The close-fitting granite blocks with dressed heads are 5 to 5½ inches in depth, 3½ to 4½ inches wide on top and 8 to 12 inches long.

Such pavements on completed contracts have cost $3.76 a square yard, and contracts were let for construction in 1914 at $3.91 a square yard for paving and $4.20 for repaving. One contract completed in 1914 was let as low as $3.40 a square yard.

ABOVE: *Modern dressed granite block used in street railway crossings on streets paved with wood blocks.* BELOW: *Difference between old granite block and split redressed granite block on Broad Street near Lehigh Avenue, Philadelphia, Pa.*

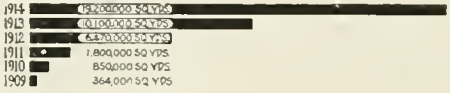
In the business section of the city these modern dressed granite blocks have been substituted in the intersections of street railway tracks for wood blocks in the wood block pavements at intersections on Market and Arch streets. The street rail-

way tracks are laid on the ordinary subsoil on the bed of the street, which results in so much vibration of the rails that the pavements thruout the city are suffering to a very great extent. The wood block in these intersections seldom lasts over six months. Possibly the granite blocks will not be very much more durable, as it is apparently impossible to hold any pavement down under such conditions.

One of the accompanying photographs shows the difference between the old granite block pavement and the new, modern dressed block on Market street. Another shows the granite blocks in a street railway intersection on a wood paved street. A third shows the difference between an old granite block street and relaying with split and redressed blocks, being two halves of the same roadway.

Increase in Use of Concrete Pavements

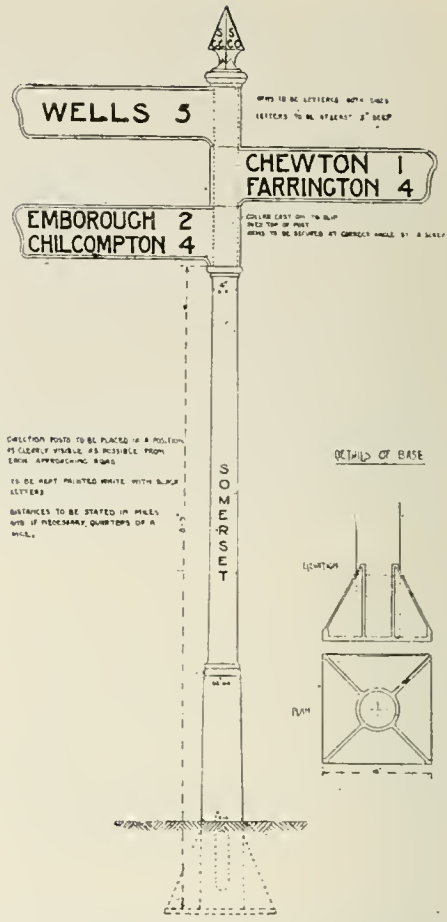
The accompanying diagram shows the increase in the use of concrete in road and street pavements in the past five years. The figure for 1914 is, of course, an estimate, but is believed to be less rather than more than the actual amount constructed.



Guide Post In England

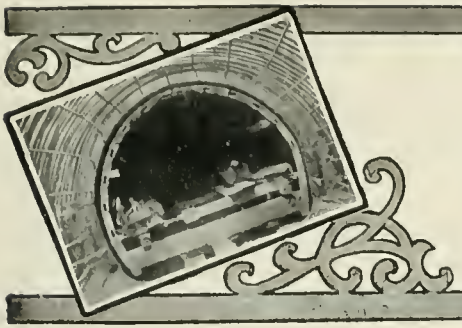
The accompanying drawing, reproduced from *The Surveyor and Municipal Engineer* of London, shows a post designed by H. T. Chapman, the county surveyor of Somerset. The post is of half-inch metal, the base 6¾ inches in diameter at top and 7 inches at the ground level. The main riser of the post is 4 inches in diameter. The cast iron base is 18 inches square and is buried about 15 inches in the ground. It can be bolted to a concrete foundation if desired and the lower section of the post is set in a braced cylinder rising from the base plate. About 8 feet above the base the post has a collar, which fixes the location of the road signs.

These direction plates are of cast iron, each with collar to slip over the top of the post and they are fastened in by an ornamental finial with a collar. As many



direction plates can be used as there are roads, the length of the post being chosen to suit the location. The letters are intended to be at least 3 inches deep, but vary according to the number of towns to put on and the lengths of the names. Mileage to turns is given in even miles and, if necessary, quarters. The names are cast on the plates and letters are painted black, post and plates being painted white. Letters are put on both sides of plates so that they can be read from either direction. The plates are fastened in place to point in the directions required by means of screws. The name of the county is cast on the post itself.

Posts are placed in position to be as clearly visible as possible from each approaching road.



SANITATION

The Sampling of Sewage

By G. Bertram Kershaw before the Annual Congress of the Royal Sanitary Institute at Blackpool, England.

A very usual object for which samples of sewage and various other liquids are taken is to ascertain the chemical or bacterial quality of the liquid sampled, and thereby to determine the degree of efficiency with which a particular plant is performing its functions; as, for example, the purification effected on a particular sewage by tank treatment and percolating filters. Again, samples may be taken simply with a view to finding out whether the quality of the liquid produced complies with a particular standard.

In the former case, in order to be in a position to judge of the efficiency of the plant, it is necessary to know the strength and character of the sewage as well as the quality of the effluent. In the latter case this is unnecessary, the sample either passing or failing to pass a given standard.

It is of the highest importance that the sample analyzed shall be duly representative of the bulk of liquid from which it is taken, otherwise erroneous deductions may be drawn. Inasmuch as quantitative analyses are necessarily somewhat costly, and gaging arrangements often involve a good deal of trouble and expense, it is very advisable, on these grounds alone, that the sample or samples drawn shall be as nearly representative as possible.

Nearly all waste liquids, especially those resulting from industrial processes, vary, not only in character but also in volume, from minute to minute, from hour to hour, and from day to day. Sewages, moreover, may also vary seasonally by reason of the influx of subsoil water and other factors; they vary markedly when heavy rainfall occurs.

If it is desired to ascertain the quality of a particular liquid at any given time, a single sample (termed a "chance" sample) will often suffice for the special or casual purpose for which it is taken. If, on the other hand, the character and strength of the liquid as a whole is what is to be determined average samples will be essential—that is to say, samples drawn according to the rate of flow of the liquid over at least four days.

It will be obvious in the case of sewage liquors, which in dry weather vary in strength roughly according to the rate of flow, that if the hourly proportional flows for five consecutive hours are 10,000, 30,000, 50,000, 60,000 and 20,000 gallons then samples merely drawn in equal quantities every hour will not represent the average strength of the liquid for the five-hour period unless the sewage is hourly of constant strength; whereas, if the samples are drawn hourly according to the rate of flow in quantities of, say, 100 c.c., 300 c.c., 500 c.c., 600 c.c., and 200 c.c., and mixed together, an average sample closely approximating to the truth will result. It follows, therefore, that in sampling for average strength the hourly rate of flow of the sewage must be ascertained; in other words, the flow must be gaged continuously while sampling is in progress.

Average samples of sewage liquors were taken as long ago as 1872 by the committee of the British Association at the Romford sewage farm, and probably long before that date, for liquors other than sewage. Average samples of sewage liquors have also systematically been taken by the Sewage Disposal Commission appointed in 1898, and it may be of interest to describe the method of taking average samples of sewage from start to finish.

The first preliminary to be settled is the duration of the period over which the samples are to be taken. In the majority of cases, four sets of twenty-four hours average samples, commencing Monday morning and ending Friday morning, will give a good idea of the character and strength of the sewage. In the case, however, of a large town, sets of average samples extending over seven days, repeated at different seasons of the year, may be necessary. In the case of domestic sewages from small communities, the first four or five days of the week usually constitute a sufficient period to provide data upon which, say, works could be designed, the

omission of sampling the Saturday and Sunday sewage, which is often weaker than normal on these particular days, provides a certain factor of safety.

It is always desirable to draw average samples of sewage in dry weather, and hence it is necessary to determine what shall be regarded as dry-weather sewage flow.

¶ THE EFFECT OF RAINFALL *upon dilution of sewage must be carefully provided for in collection of samples.*

The extent to which rainfall will affect the sewage flow will depend very largely upon local conditions, such as the nature of the sewerage system, the character and gradients of the surfaces of the drainage area contributing to the sewers, together with many other factors: but it depends, other things being equal, chiefly upon the intensity of the rainfall. For example, a rainfall of .05 inch, or even more, following dry weather, and spread evenly over several hours, may produce little or no appreciable effect upon the flow of sewage, certainly not sufficient to put a stop to the taking of samples; but the question of continuing or abandoning drawing of samples must be left to the discretion of the sampler, who will generally be able to gain some idea from the sewage works manager as to whether or not the sewage flow is being materially affected by rainfall.

If two or three days precede the sampling operations, so much the better: but it is impossible to predict seven to ten consecutive days of dry weather in this country.

Since an automatic height recorder in connection with the gaging operations is advisable whenever it can be obtained, it is a good plan to fix a weir and run the recorder for seven to ten days before actually commencing sampling, thus obtaining a series of charts showing the general run of the sewage flow; comparison with these charts when rainfall occurs will generally show when it is inadvisable to continue sampling for the time being.

With regard to rainfall records, at most sewage works of any size a rain gage is kept on the works, but if there is not one in use, a 5-inch gage is easily erected, and records should be taken at 9 a. m. daily during the sampling. If a rain gage is to be found in the town itself, daily records should be obtained from this source also, as it by no means follows that the rainfall in the town and on the works will be identical.

Now, as regards the apparatus required for taking twenty-four hours average samples of crude sewage, about thirty, or, better still, thirty-six wide-mouthed, glass-stoppered bottles will be needed for chemical analysis; the use of the extra bottles (apart from chance of breakage) will be apparent later.

¶ THE APPARATUS *for taking samples is simple but there must be plenty and it must be carefully manufactured and prepared for use.*

If samples for bacterial analysis are needed, a few small glass-stoppered sterilized bottles will also be wanted; these will generally be sent ready sterilized direct from the laboratory, and one or two of such bottles can be filled from the large mixing bottle when the twenty-four hours' average sample is made up. The stoppers of all the bottles, both chemical and bacterial, should be carefully ground in with fine emery, and the foot of each stopper rounded to avoid shutting in air bubbles.

As regards capacity, the larger bottles should hold about 600-700 c.c. each, and the sterilized bottles about 50 c.c. each. A large glass mixing bottle, holding about 1½ gallons, will be wanted for making up the average sample from the twenty-four separate hourly samples, and also a couple of thick glass stirring rods, and a measuring glass graduated in cubic centimeters; two thermometers, grease chalk, two or three drying cloths, and some adhesive labels complete the outfit. The bottles used for holding the mixed twenty-four hours' average sample are generally half-winchesters, holding about 1,300-1,400 c.c. each: but for special purposes a winchester is sometimes required.

Turning to the gaging outfit required: The method of gaging employed will depend upon local conditions. Whenever practicable, a wooden dam, with a brass or gunmetal rectangular weir plate screwed to the face of it, is the simplest method, the whole of the flow to be gaged passing over the weir, and the depth of liquid over the weir still being registered continuously by an automatic height recorder. "Plastic," or a mixture of clay and boiled linseed oil, is useful for making watertight joints between the margins of the wooden dam and the channel walls.

It may be well to point out here that to avoid complications in the formula for discharge, owing to the existence of material velocity of approach, one or two points need to be kept in mind.

1. The width of the weir should not exceed about one-third the width of the channel in which it is placed.

2. The transverse sectional area of the liquid falling over the weir should not

exceed about one-fifth of the transverse sectional area of the liquid in the channel immediately above the weir.

3. The weir and dam board should be perfectly upright, and have a free overfall and air space underneath the falling sheet of water, while the float of the automatic recorder should be placed sufficiently far back from the weir to avoid curvature of surface.

¶ THE RECORDER *of the flow of water over the weir in the sewer is an important part of the apparatus.*

As to the type of recorder, I have always used a small portable Glenfield and Kennedy machine, the drum being driven by a seven-day clock, and the pen actuated by the up and down movement of the float. There are, however, several automatic height recorders on the market, some of them with pen or pencil cams cut to give the discharge direct upon the chart. It is not, however, a difficult matter for any engineer to construct a simple and reliable machine for comparatively little outlay. Care is required in adjusting the pen to zero on the chart, which should be carefully pressed down to the rim at the foot of the drum.

Most recorder pens have an up and down range of 6 inches, so that the depth over the weir must be limited to about 6 inches, unless the minimum early morning flow exceeds, say, 1½ inches depth over the weir, in which case the recorder can be made to register up to 7½ inches by setting the pen at zero on the chart when exactly 1½ inches of liquid is passing over the weir, the chart base line thus reading 1½ inches above sill level. The recorder should be set up perfectly level, and the float, if in an exposed situation, should be surrounded by a cylinder of fine perforated zinc, to eliminate wind action, otherwise oscillation of the float will soon exhaust the ink in the pen, besides blurring the chart. It may be mentioned that a mixture of glycerine and cochineal, or any aniline dye, makes a good ink for a recorder pen.

Having erected the weir and recorder, the sample bottles should be prepared and the time for commencing settled. Assuming 9 a. m. to be the hour determined upon, and that average samples of crude sewage are to be taken, the recorder should be started at 9 a. m., and the first sample of sewage taken at 9:30 a. m., the second at 10:30 a. m., and so on hourly until 8:30 a. m., the following morning, when the first set of twenty-four hourly samples will be complete. The filling of each bottle is usually most conveniently done at the weir outfall.

It will be found convenient to write on each bottle the nature of the liquid, the date and the hour of drawing; this can be done with grease chalks upon the glass direct, or adhesive labels can be used.

As each hourly bottle is filled the stopper should be allowed to sink down gently into place in the bottle neck; if this is not carefully attended to there is considerable risk of casualties when an attempt is made forcibly to unstopper the bottle. After stoppering the bottles should be set in a row in the order of the times at which they were filled. It will be found, when the twenty-four bottles are ranged in a row, that a wonderfully good idea can be obtained visually of the variations in the character of the sewage thruout the twenty-four hours.

¶ THE STEPS IN THE PROCEDURE *are set out in detail that the results may be fully explained and comparable, conditions being fixed as closely as possible.*

A point now arises as to the inclusion of fragments of fæces in a sample. Altho they are usually omitted when taking chance samples direct with half-winchester bottles, this would appear to be a faulty method of sampling in certain cases, especially where the crude sewage subsequently undergoes treatment in septic tanks. If they are included they will need to be broken up in the hourly sample bottles before the proportionate amounts are drawn off.

After the last of the twenty-four hour samples has been taken, and the recorder pen has reached the 9 a. m. ordinate on the chart, the chart can be removed and replaced by a fresh one, and the hourly rates of flow worked out and entered up on the finished chart. The date, rainfall (if any) and other notes of interest should be recorded, such as times of weakest and times of strongest sewage, flushes of trade wastes, etc. For working out the hourly flows on recorder charts I use a special slide rule, which has the advantage of shortening the labor considerably. In the case of a recorder provided with a cam, the discharge can, of course, be taken direct from the chart, but with a recorder that only registers the height, height diagrams have to be translated into discharge diagrams.

The next step is to take from each bottle, commencing with the 9:30 sample, an amount proportionate to the rate of flow for each hour, and to transfer it to the large mixing bottle. Assuming the flow for the first three hours to have been severally 5,000, 6,500 and 8,500 gallons per

hour, then if 50 c.c., 65 c.c. and 85 c.c. are taken from the first, second and third bottles respectively, these amounts will be proportionate to the rates of flow for those hours, and the same procedure must be followed with the twenty-one remaining hourly samples.

The measurement of the liquid from the hourly sample bottle is best effected by means of a tall glass cylinder graduated in cubic centimeters. Before the sample bottle is unstoppered it should be turned over once or twice to mix the contents and any large solids should, if present, be broken up with a glass rod. In many cases the hourly amounts to be taken from each bottle can be obtained by knocking off two or more figures from the right of the hourly rates of flow, and if the figures thus obtained are inconvenient, the whole of these can be either divided or multiplied by a common factor. Care should be taken that the aggregate of the figures adopted is sufficient to yield enough liquid for the final sample; and it is better, if this can be done, to take sufficient liquid to fill two half-winchesters in case of breakage of one of them.

The working out of the chart and the sub-sampling, together with the entering up in the proper hour-spaces of the chart of the times of strongest and weakest sewage, presence of trade wastes, etc., take some considerable time; and while this record is in progress the reserve bottles previously mentioned will be needed to take the first few hours of the second set of samples.

¶ THE METHOD *of obtaining an average sample of the twenty-four hours flow of sewage must be followed closely.*

When the proportionate contents of the twenty-fourth hourly sample bottle have been transferred to the mixing bottle, the whole of the contents of this large mixing bottle should be gently agitated while the half-winchester bottle or bottles are being filled from it, in order to keep the suspended solids evenly distributed thruout the liquid. After the half-winchesters are thus filled, the hourly sample bottles can be emptied, washed out with clean water and set to drain. In cold weather, half-winchesters, or winchesters, filled with sewage, tank liquor or effluent, should be filled brimful, and the stoppers gently worked in, and tied down with a piece of calico or string; in hot weather, and also in keen frosty weather, a small air space may be left at the top of the bottle in the case of sewages or tank liquors. The samples should be dispatched to the laboratory carefully packed in wicker cases or hampers, nothing being better than old crumpled newspaper for packing the bottles in. It is often useful to have a special sample of the weakest early morning sewage, taken in a half-winchester, to be examined for nitrates. These, if present, indicate the presence of subsoil water in the sewage.

It may be noted that in the case of very small sewage works, where an automatic height recorder cannot be obtained, depths over the weir can be taken with a thin steel rule, one edge of which is ground thin. Depths should be taken sufficiently far from the weir sill to avoid curvature, and it will be found that if the rule is rubbed lightly against a block of wet clay and allowed to dry before each reading, the exact depth can easily be seen at a glance. The gaging of sewage flows in this way is very tedious, since readings should be taken every ten minutes, or at even shorter intervals, should the flow of sewage fluctuate much, as will almost certainly be the case with a small sewage works. At least three observers are needed for the twenty-four hours for taking sill depths and drawing samples.

¶ AN ALTERNATIVE METHOD *of obtaining an average of samples instead of an average sample is described.*

There is another method of taking average samples, in which samples are taken at regular intervals thruout the twenty-four hours, each of these samples being analyzed separately; a "weighted sewage" can be obtained by multiplying each separate analysis by the rate of flow at the time the sample was taken, the results are then added up and divided by the total flow.

Some years ago the writer, having occasion to take a large number of average samples, designed an instrument for taking samples directly proportionate to the rate of flow in one operation. Briefly described, the instrument consisted of a paraboloid copper tube or container, about 12 inches long, ranging from ⅝ inch at the bottom to about 2¼ inches at the top, the several diameters being calculated from the gaging formula. This tube was attached to a sliding metal stem working up and down in sockets screwed on to a rod provided with a thin sole plate, upon which the tube rested when the sample was taken. When in use the tube was raised clear of the sewage tank liquor or effluent, and the sole plate placed on the measuring stud, which was about ¼ inch —*i. e.*, the thickness of the sole plate— below the level of the weir sill. The tube was then dropped thru the liquid on to

the sole plate, and the intercepted liquid poured off direct into the mixing bottle; a thin rubber pad lying in a recess in the foot or sole plate prevented any escape of liquid, while a strong clip at the head of the instrument kept the container tube well home against the rubber. In this way, at each sampling, a portion of liquid was withdrawn proportionate to the flow of liquid; in other words, proportionate to the height of the liquid flowing over the sill. Like most automatic contrivances, however, while possessing many marked advantages with certain liquids, containing suspended matter of moderate size, it had also several drawbacks, and the longer and more tedious method already detailed is to be preferred in most cases.

There are home-made automatic samplers to be seen in use at several sewage works, most of them actuated by a small water-wheel driven by a flow of sewage, tank liquor or effluent.

Municipal Swimming Pools

The city of Denver, Colo., has paid much attention to swimming pools and several of its parks are provided with them. The pool in Sloan and Cooper Lakes park is shown in part in the accompanying photograph.

Cooper Lake represents the city's most recent effort to develop a swimming pool. It is especially interesting because it shows the gradual process by which a natural body of water is changed into an attractive bathing beach. First a life guard was secured; then the old tent which had served as a bath house at Washington Park was taken down from the attic of the work house and removed to Cooper's Lake to serve once more. Next a boat was borrowed. Thus, with life-guard, boat and tent, "the old swimming hole" at Cooper's Lake has come under the supervision of the city and all who will are invited to come out and have a swim. Still there are weeds and mud, but what does a boy care for these?

If the numbers that come steadily increase, as doubtless they will, the city will from time to time make such improvements as seem desirable and in this manner Cooper Lake, the most typical swimming hole in Denver, will be changed into a well equipped bathing beach.

Sewage Disposal in Montana

From a paper by A. L. Jaqueth, of Kalispell, Mont., and the discussion of it, the following is taken regarding practice and results in that state:

The septic tank is an elongated tank or basin, thru which the sewage is allowed to flow at a very slow rate of speed, the effluent water passing over a weir and then thru the flush tank and intermittent filter beds.

While the sewage is slowly passing thru the tank, the heavier particles of organic or mineral matters sink to the bottom. The former is immediately attacked by the anaerobic bacteria, which rapidly multiply to countless millions,

SWIMMING IN COOPER LAKE *a preliminary stage to the park swimming pool which follows when the demand becomes too great for the few facilities offered in this suburban park.*

and quickly break up the organic matter into its gaseous and mineral constituents, the latter sinking to the bottom of the tank, the former rising to the surface and passing off into the atmosphere. In this manner the sewage is prepared for the filter beds.

Sewage disposal plants having sand filters should remove 85 to 98 per cent. of the organic matter from the sewage, and 98 to 98.8 per cent. of the bacteria.

A sewage treating plant with septic tank and sand filters, installed by Mr. Jaqueth, worked as follows After having been installed for five months, and after the first few weeks of installation, the effluent was perfectly clear and without odor, and no deposits have been formed in the many water holes along the outlet.

Immediately below the disposal plant, below the old sewer outlet in this small water course, before the plant was built, the sewage had been retained in the creek until a regular settling basin had been formed, which on warm days was very offensive, a constant ebullition being present. The appearance of the creek for about a mile below the outlet was that of a black, bubbling mass, which, if stirred with a stick, would give off a stench such that it was impossible to remain near. One of the farmers living about one-fourth of a mile from the sewer outlet sued the city for damages for maintaining a nuisance, and collected $2,500. Several others had informed the city that unless the nuisance was abated they would commence similar suits against the city.

Since the plant has been in operation, all nuisance has disappeared, and the water in the creek is now clear and fresh. The hole just below the plant, which was formerly a nuisance and a menace to health, is now perfectly clear, without any odor whatever. This disposal plant cost approximately $3,000 and is used by a town of approximately 1,200 people.

The tank is about 7 feet deep and 7 feet by 20 feet square. After six months use there was about 3 feet of sludge in the bottom. They drew it off on to a sludge bed, about 90 per cent. of it being water. After the sludge had dried you could take it up in your hand and breik it up, and it was almost like a powder, a black powder. The tank treated about 100,000 to 120,000 gallons of sewage a day.

Butte never needs to have any purification as long as the state authorities allow the city to use Silver Bow Creek. There are no people or communities on the stream below Butte that use the water, and, in fact, the water is already polluted before it reaches the city from the mills and concentrating plants.

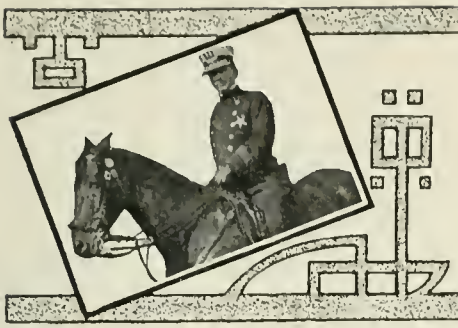
Bozeman as the result of what experiments will be carried on under the direction of the college and board of health and the city will choose some sort of disposal plant and make a bond issue to take care of it.

There has never been any discussion by the citizens of Great Falls on the subject of sewage disposal. It is approximately 2,000 miles before the water is again used as a domestic water supply. The constant unsatisfactory condition of Milk River is sufficient in itself to make the water supply of the Missouri River unsatisfactory unless the water is purified by some of the mechanical means at present in vogue. Above the Milk River there is only one town that would ever need river water, Fort Benton. At the present time they are supplied from a well system, and have received such concessions in the matter of power that they cannot save anything by going to the river. The one other community that is in any wise influenced is an adjacent community on the other side of the river, and steps are being taken at the present time to include that platted ground within the corporation limits of the city of Great Falls. When that is done its water supply can be connected with Great Falls and make it unnecessary for them to use the river water. In the early spring there has been a great amount of typhoid fever, but after the installation of a hypo-chlorite treating plant at their pumping station this epidemic immediately abated, and at the present time there are practically none of the typhoid cases left on that side of the river. Aside from this, the condition of the river below Great Falls is very satisfactory to facilitate self-purification. Behind the dams is sedimentation, where organic matter will be settled out and settle the sludge in the bottom of the river; passing the dam it passes over cataracts, dams and riffles to be thoroly aerated.

The State Board of Health has some control over sewage and water purification, as well as plans for sewerage and water supply, and has issued instructions for preparing plans for submission to the board. The board has some power which it can use in forcing sewage purification, in addition to its power to approve or disapprove of the plans presented by a municipality.

Portland Cement for Argentina

Consul General R. M. Bartleman, of Buenos Aires, Argentina, has forwarded to the Bureau of Foreign and Domestic Commerce a copy of conditions for supplying portland cement destined for public works in that country. He has also sent a translation of the principal portions of the document, which may be obtained by interested persons.



LEGAL DECISIONS

Electric Company Cannot Refuse Service

The Appellate Division, by overruling unanimously an order of the Public Service Commission, First District, New York, has made an important decision concerning the obligations of lighting and power selling corporations to the public. C. Perceval, a provision merchant, made application on July 13 last year to the New York Edison Company for a supply of electric current for lighting, power and storage and refrigerating purposes. When the standard forms of contract were sent to him, he struck out the clause forbidding the use of other electric service without the previous written consent of the New York Edison Company, on the ground that he had already contracted for electric current from 7 a. m. to 5:30 p. m. from the Wing Building, next door, which had a private generating plant.

Then the New York Edison Company refused to supply current for only certain hours during the day, and, says the Appellate Division, placed "itself squarely upon the position that it was under no obligation to furnish electric current to any one unless that person agreed to take from the company all the current which he required." Mr. Perceval applied to the Public Service Commission, but it gave a decision in favor of the corporation, and it was from its ruling that the appeal to the Appellate Division was taken.

This court now decides that, in consideration of the privileged position of the New York Edison Company, not the least of which is the right to use the public streets and highways for carrying its conduits, it is bound to serve impartially every member of the community who demands its services. It may, the court acknowledges, establish reasonable regulations which the consumer must observe, but the requirement that a consumer must take all of his electricity from one company or receive none "is not in any proper sense a regulation respecting the use of the service, but it a purely arbitrary attempt on the part of the company to insure to itself a monopoly of furnishing electrical current."

If that were permissible, the court points out, the company could also refuse to furnish current to a consumer who was manufacturing for himself part of the current he needed, and this had already been severely condemned upon grounds of public policy. Moreover, if the company had established the fact that the hours during which the supply of current was asked of it were those in which the greatest demands were made upon its services, this condition could have been met by making a special rate for the service.

So the case was sent back to the Public Service Commission to make such orders as might be proper.

Massachusetts City Cannot Reduce Gas Rates Below Cost

The application by the Municipal Light Board of the town of Wakefield, asking that the Massachusetts Board of Gas and Electric Light Commissioners consent to the establishment of certain prices for gas, alleged to be less than cost, has been refused.

The town owns both a gas and an electric plant which it has operated since 1894. The prices which the Municipal Light Board and Manager proposed to establish were $1.40 gross a thousand cubic feet for gas, with a discount of 20 cents for prompt payment, or $1.20 net. The present prices are $1.50 per 1,000 cubic feet, with a discount of 20 cents for prompt payment for 100 to 19,900 cubic feet, 30 cents for 20,000 to 29,900 cubic feet, 40 cents for 30,000 to 39,900 cubic feet, and 50 cents for over 40,000 cubic feet a month.

With respect to the price of gas, the board, from its examination since the hearing, is convinced that the operating expenses alone of the gas business exceed $1 a thousand cubic feet of gas sold. During the fiscal year ending June 30, 1913, they amounted to nearly $1.12; for the calendar year 1913, by reason of larger sales and a somewhat better disposition of

residuals, this operating cost was reduced to $1.05. For the past two and a half years it has averaged $1.08. In addition to the operating costs, the statute requires the price to include interest on the investment, the maturing debt requirements and the depreciation reckoned at 5 per cent. on the cost of the plant. There is a fair chance for some difference of opinion as to the amount of the investment, but upon the basis most favorable to the petition of the management, these fixed costs have exceeded 40 cents. Even if depreciation be reckoned at 3 per cent., as is permitted for a different purpose by chapter 411 of the Acts of 1906, and if the maturing debt requirements are omitted, these fixed charges have exceeded 30 cents. The average net operating expenses for the past two and a half years have been $32,700, and the average annual sales, 30,129,375 cubic feet. It thus appears that if all this gas had been sold at $1.20, the resulting revenue would not have been sufficient to pay 4 per cent. on the gas investment and make any provision for depreciation.

In view of these facts it is reasonable to expect that, if the board's consent is given to the establishment of the proposed maximum net price, all of the gas supplied by the plant to its consumers will be sold at a substantial loss. A reduction in price often stimulates a demand which results in an increased output without a corresponding increase in cost, and the business problem which this fact suggests is always to be considered. But in this case there is no sufficient reason to believe that a loss so substantial is likely to be absorbed by the increase in output to come from the lower price. The last annual statement of the financial condition of the business indicates losses which have not yet been recovered. Without an extensive and thoro investigation it is impossible to determine when or how this loss occurred, and for the decision of the present case this seems to be unnecessary. Some portions of former losses have been recently regained, particularly in the last three years. Until these can be further reduced, however, it would seem to be the part of ordinary business prudence for the town to require consumers of gas to pay all the operating expenses and fixed charges.

In view of the foregoing consideration, the board has voted to refuse consent to the net price of $1.20 for gas to be sold and delivered by the town of Wakefield.

Decisions of the Higher Courts of Interest to Municipalities

Right to Percolating Water Under Property not Acquired with Property.—A town, which pursuant to St. 1908, c. 404, acquires land bounded by a stream for a water supply, does not acquire the rights of an owner of percolating waters under the land; and where it drills wells, and thereby intercepts water which would otherwise flow into the stream and a millpond, it is liable for the taking of property of the owner of the pond. The same statute makes the town liable for compensation to persons damaged in acquiring its water supply.

Acceptance and Substantial Performance of Contract.—Where the board of public works of a city refused to approve a street improvement work, because not in compliance with the contract, and then directed the city engineer to determine what deductions from the contract price should be made for noncompliance, and the city engineer reported that a deduction of a specified sum would cover the difference between the improvement as constructed and its value if in strict compliance with the contract, and thereafter the board accepted the improvement on the contractor's filing an acceptance of a settlement calling for a reduction of the specified amount from the contract price, and certificates were subsequently issued by the board, the board accepted and approved the work and adjusted the claim of the contractor. Substantial performance of a street improvement contract is performance, provided no damage is suffered by the contractor's failure to literally perform. Transfer Realty Co. v. City of Superior (Wis.:), 147 N. W., 1051.

Remission of City Taxes Valid Return for Water.—In 1879 the city of Millville agreed with the Millville Water Company that, if the company would erect a plant and do all things necessary to supply the city with water, the city would take such supply, and would annually, in compensation therefor exempt the water company "from the payment of all taxes except those levied for state and county purposes." In 1912, in violation of this agreement, the city having received its water supply, compelled the water company to pay the tax due to the city for that year. Thereupon the water company sued the city for the price of the water so furnished, fixing in its complaint such price as the amount of the tax so paid. On a motion to strike out this complaint on the ground that the agreement to exempt from payment of taxes was void as against public policy, *held*, that, as between these contracting parties, the true construction of the agreement was that the city would pay for the annual supply of water furnished to it by the water company a sum equal to the amount of the tax payable for that year by the water company to the city. Millville Water Co. v. City of Millville (N. J.), 90 Atl. 1907.

Municipal Notes

A Brick Road As A Monument

Near Pana, Ill., John W. Kitchell, is laying a brick pavement in honor of his father-in-law, a pioneer in Christian county, which will be known by his name as the Robert Little road.

This is the first brick highway to be laid on the country roads of central Illinois. It will be 3¼ miles long and will extend from the village of Rosemond to the Rosemond Grove Cemetery, a country burying ground five miles west of Pana.

The width of the brick portion is 16 feet from curb to curb. On one side will be a dirt road 10 feet in width and on the other side a dirt berm of 4 feet. Beyond these dirt strips will be side ditches to carry off the water.

Captain Kitchell has two other reasons for building it:

To give the people of the village of Rosemond a pleasant drive for their funerals when bad weather makes the dirt roads impassable.

To encourage the building of good country roads, not alone in his own community, but thruout the state.

It will be the only public highway in Illinois not paid for by the sale of bonds. The $55,620 to pay for its construction is waiting till the contractor finishes his work.

Bond-Terms for Constructing Public Works

The following resolutions presented to the Convention of the American Society of Engineers, Architects and Constructors, by Col. J. W. Howard, of New York, Consulting Engineer on City Planning and Pavements, were unanimously adopted:

"Whereas, One of the important elements of good government and its continuance in the cities, counties and states of our Nation, consists in sound, honest financing of public works; and,

Whereas, A pernicious practice has appeared in many places, of issuing public bonds for terms longer than the life of the pavements, roads, sewers, waterworks, bridges, some public buildings, etc., for which such bonds have been sold; and,

Whereas, Such a practice places unjust tax burdens upon us later in life, and puts our children in debt, some before they are born; and for things which they will have never used nor seen.

Wherefore, Be it Resolved, That the Society of Engineers, Architects and Constructors, protest against bonds for public improvements and works, being issued for periods of time longer than the reasonable life or durability of the several kinds of construction, for the payments of which said bonds are issued by cities, counties, states or the U. S. Government; also that it is certain that more continuous employment of capital, engineers, architects, constructors, artisans, mechanics and laborers; also greater and steady prosperity, will hereby be assured."

San Francisco's Municipal Band

San Francisco's Municipal Band is over two years old, having celebrated its second birthday on July 1. During the two years it has given one hundred and twelve entertainments, to the delight of many thousands of people.

It has been the aim to give every section of the city an opportunity to enjoy the high-class music produced by the band, and over forty districts have been visited.

Nearly all of the smaller parks have been provided with music on at least one occasion and also all of the playgrounds. In sections not favored with these public spaces, school house grounds have been utilized, to the advantage of the people of the neighborhood.

It is a significant testimonial to the salubrity of San Francisco's climate to state that during the past two years only three concerts had to be postponed on account of the inclemency of the weather. Winter and summer, the concerts are held in the open air.

The local improvement clubs have cooperated to make the gatherings a success and have frequently added other attractions to that provided by the band.

So popular has become the Municipal Band that a demand is being created for its services at evening street dances, and if ways and means can be found, an attempt will be made to meet this demand.

The Supervisors appropriated $10,000 a year to support the band. The Publicity Committee of the Board arranges for the concerts, except that the musical program is prepared by John A. Keogh, the director.

Regulation of Automobile Traffic

The police department of Joliet, Ill., has issued the following order:

All automobilists in Joliet who stop on either side of the street on Chicago street between Jefferson and Webster streets, and on Clinton street, between Chicago and Scott streets, shall park their cars with the nose into the curb, at an angle of not less than 45 degrees and with the inside rear wheel not more than 5 feet from the curb. Cars shall be parked not less than 10 feet from any hydrant.

Congestion of traffic is the cause of this order. With the machines parked in this manner on Chicago street, any vehicle can pass between the rear of the machine and the street car tracks with ease. On all other "loop" streets the old system of parking cars will be used, on account of the narrowness of the streets.

Signs, to be erected at certain distances on all sides of Joliet schools, warning the approaching automobilists of danger, are being placed, fifty-five signs having already been erected.

Good Roads Movement in Northern Illinois

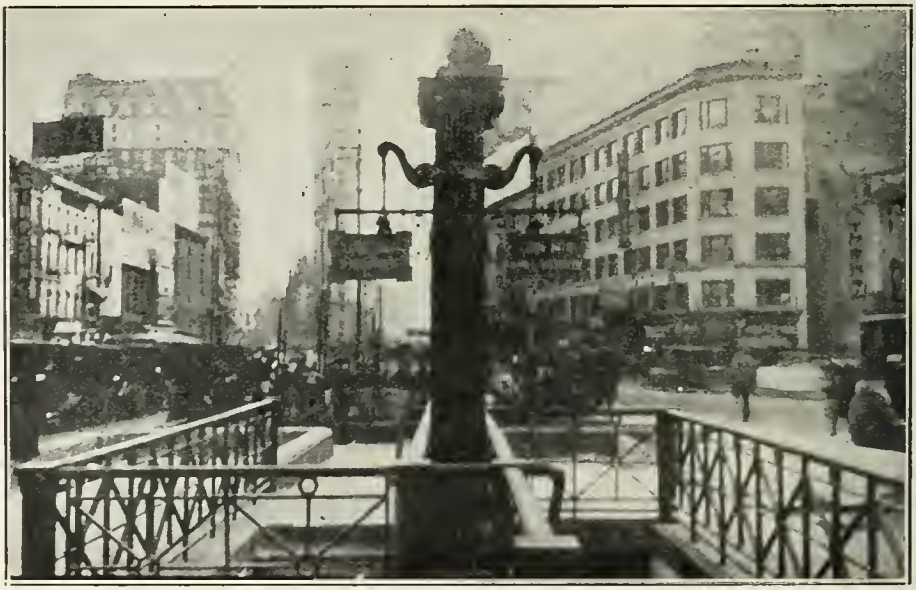
A committee from the Will County (Illinois) Automobile and Good Roads Association will appear before the county board in December and ask that a $500,000 bond issue be submitted to the vote of the people.

Amendment of the Tice good roads bill, passed at the last session of the legislature, so as to include macadam roads in the list of state aid roads, will also be urged by the club.

Efforts of the club will be directed next spring to the completion of the Chicago-Joliet automobile highway, and energies to have the next state aid money expended on this twenty-nine-mile stretch will be used.

Public Comfort Station in New York

The photograph shows one of the types of public comfort station in use in New York, which now has many of these conveniences in use. The stairway to the left is for men and that to the right for women, running in opposite directions but without a man-high screen between them above the sidewalk level.



Lighting

Ornamental Lighting by Assessment

The city of Spokane, Wash., establishes ornamental lighting districts and provides for the assessment of the cost on the property benefited. Thus the First avenue system is extended under a resolution reading as follows:

Notice to Property Owners of Hearing on Resolution for First Avenue Ornamental Street Lighting System, Bernard Street to Cedar Street.

Be it resolved, by the city council of the city of Spokane:

That it is the intention of said council, and such intention is hereby declared, to order the improvement of First avenue, in the city of Spokane, from Bernard street to Cedar street, by the installation and maintenance of an ornamental street lighting system thereon.

The nature and territorial extent of such proposed improvement are as stated above.

The cost and expense thereof is to be borne in whole or in part by the property specially benefited thereby, and the boundaries of the proposed assessment district are particularly described as follows, to-wit:

Beginning at a point on the west line of Bernard street 90 feet north from the north line of First avenue; thence west along a line parallel to and 90 feet north from the north line of First avenue to the east line of Cedar street; thence south along the east line of Cedar street to a point 90 feet south from the south line of First avenue; thence east along a line parellel to and 90 feet south from the south line of First avenue to the extended west line of Bernard street; thence north along the extended west line and the west line of Bernard street to the point of beginning.

That a hearing on said matter will be held before said council in the council chamber on the 3rd day of August, 1914, at 2 o'clock p. m., at which time and place all persons who may desire to object thereto may appear and present such objections, if any they have.

The commissioner of public utilities is hereby directed to submit to the city council at or prior to the time fixed for said hearing the estimated cost and expense of said improvement and a statement of the proportionate amount thereof which should be borne by the property within the proposed assessment district, and a statement of the aggregate assessed valuation of the real estate exclusive of improvements within said district, according to the valuation last placed upon it for the purposes of general taxation, together with a diagram or print showing thereon the lots, tracts and parcels of land and other property which will be specially benefited thereby, and the estimated amount of the cost and expense of such improvement to be borne by each lot, tract or parcel of land or other property.

Rules of New Hampshire Public Service Commission Respecting Gas Supply.

The Public Service Commission of New Hampshire has issued (effective February 1st) rules prescribing standards for purity, pressure and heating value of gas, and otherwise regulating the service of gas utilities, from which the following extracts are taken. It is worthy of note that nothing is said as to candle power or photometric tests, the thermal value being accepted as the determining factor.

A cubic foot of gas shall be taken as the quantity in a volume of 1 cubic foot when saturated with water at 60 degrees F., and under a pressure of 30 inches of mercury.

No utility shall supply gas having a monthly average total heating value of less than 600 B.t.u. per cubic foot, tested anywhere within one mile of the manufacturing plant; and at no time shall the heating value be less than 550 B.t.u.

Each utility which in any year shall

have sold more than 20,000,000 cubic feet shall equip itself with a calorimeter and shall determine the heating value of its gas on at least three days in the week. A record of each such test shall be made and be open to the public.

No gas shall contain more than 30 grains of total sulphur, or 10 grains of ammonia, per 100 cubic feet, or more than a trace of hydrogen sulphide. Gas shall be deemed to contain more than a trace of hydrogen sulphide if a strip of white filter paper, moistened with a solution $6\frac{1}{2}$ per cent. by weight of lead acetate, after being exposed for 1 minute to a stream of the gas flowing at the rate of approximately 5 cubic feet per hour, the gas not impinging directly from the jet upon the paper, appears perceptibly darker than a second paper freshly moistened with the same solution.

Each utility shall daily test the gas leaving its holders for the presence of hydrogen sulphide in the manner specified, and shall keep a record of such tests.

The commission will, from time to time, inspect the methods of manufacture, and test the quality of gas supplied. A fee of $15 will be collected from the utility for each such inspection.

Gas pressure, as measured at the outlet of the service to any consumer, shall never be less than 2 inches nor more than 8 inches water column. The maximum daily pressure variation shall not exceed 3 inches water column.

Each utility shall provide itself with one or more portable recording pressure gages, and shall regularly, and not less frequently than the commission may direct, make measurements of the gas pressure, and pressure variation thruout the system. Records of these measurements shall be kept open to public inspection.

No gas meter shall be placed in service which has an error in measurement in excess of 2 per cent. when passing gas at the rate of 6 cubic feet per hour per rated light capacity of such meter.

All new meters purchased, and all old meters which have been repaired, adjusted or removed from service, shall be tested and marked with the date of test before being placed in service; and all meters shall be removed and tested at least once every 5 years. During each period of 12 months, until all such meters have been tested, each utility shall remove for test not less than 20 per cent. of the meters now in service, those longest in service being removed first.

Each utility shall, without charge, make a test of the accuracy of any gas service meter upon request of the consumer, provided the consumer does not make such request more frequently than once in 12 months. A report giving the results of each request test shall be made to the consumer.

Any gas meter may be tested by an inspector employed by the commission, upon written application of the consumer, and deposit of the fee fixed for inspection. If the meter is found to be more than 2 per cent. fast the fee paid by the consumer will be returned to him, and shall then be paid by the utility. Each application to the commission for test of a meter shall be accompanied by a fee of $1, the fee for testing any meter having a rated capacity not greater than 10 lights. For meters of greater capacity a deposit equal to the estimated cost to the commission will be required.

The commission will, from time to time, test such meters of each utility as it shall judge expedient. A fee of 50 cents will be collected from the utility for each meter so tested which is of not greater than 10 lights rated capacity, and for each meter of greater capacity a fee equal to the cost to the commission of testing the same.

Whenever a meter is tested under this rule and found more than 3 per cent. fast, the company shall return to the consumer that percentage of the amount of the bills for the previous 6 months, or for the time the meter was in service, not exceeding 6 months; provided, however, that the commission in any case may relieve the utility from this requirement to such extent as the facts may appear justly to require. Whenever a meter so tested is found to be more than 3 per cent. slow, the utility may make application to the commission for authority to render a bill to the consumer for gas supplied during the preceding 6 months, not covered by bills previously rendered; but such application should be made only in cases of substantial importance, and should be accompanied by a statement showing the utility not to be in fault for allowing the incorrect meter to be in service.

Whenever a gas meter is tested the original test record shall be kept, indicating the information necessary for identifying the meter, the reason for making the test, the reading of the meter before being removed, and the result of the test. This record must be sufficiently complete to permit the convenient checking of the methods employed and the calculations. Records shall also be kept, numerically arranged, indicating approximately when each meter was purchased, its size, its identification, its various places of installation, with dates of installation and removal, and the dates and general results of all tests.

Each utility shall maintain a suitable meter prover so located as to be shielded from excessive temperature disturbances and equipped with thermometers and oth-

er necessary accessories, and approved and sealed by the commission.

Bills rendered periodically for metered gas shall designate the reading of the meter at the beginning and end of the interval and the dates of the readings.

Each utility shall keep a record of all complaints made in regard to service, which shall include the name and address of the complainant, the date and nature of the complaint, and the disposition of the same.

Each utility shall provide, equip and maintain a station for the testing of gas and gas meters, and such equipment therefor as may be necessary for the testing required by any rules of this commission, and shall provide such facilities for the use of the commission's inspector as the commission may prescribe, to be arranged in a location and according to plans approved by the commission.

Each utility, at such times and in such form as the commission shall prescribe, shall report to the commission the result of all tests made of heating value, purity and pressure of the gas supplied by it, and the number of meters purchased, installed, removed from service, tested, adjusted and repaired.

Los Angeles Opposes Refunding of Electric Railway Bonds at Higher Interest Rate

City Attorney Albert Lee Stephens, of Los Angeles, gave a brief statement of the grounds of the city's intervention in the application of the Los Angeles Railway to the State Railway Commission for permission to consolidate certain subsidiary companies, and carry thru a comprehensive plan of financing, at a hearing a few days ago. The company seeks approval of a plan whereby it may pay as much as 6 per cent. interest on bonds, and may refund underlying 5 per cent. bonds of companies that will be absorbed in the consolidation with 6 per cent. bonds.

The financially strong position of the company is not contested by the city, nor the propriety of issuing bonds to finance extensions which are much needed. The city does not wish to place any obstacles in the way of the company's development. It feels, however, a duty in view of the possibility that municipal ownership of the utility may be desired at some future date, of asking that if it can possibly be avoided, outstanding 5 per cent. bonds shall not be refunded at 6 per cent., which will mean the addition of $230,000 annual charges.

The city also feels the commission's decision should so run that when substantial issues of securities are to be made in the future, they shall issue only upon specific permission of the commission after due proceedings in each particular case, and that rate of interest shall be determined for each issue, on the theory that altho 6 per cent. may be necessary to secure the money this year, easier financial conditions may obtain in the future, so that future bonds would command a market at a fair price altho bearing less than 6 per cent. interest.

By taking this position, the city seeks to give due prominence to the factors that would reduce interest charges upon the city treasury, in the event of the city's taking over the electric railway system, and assuming the annual charges involved in bond interest.

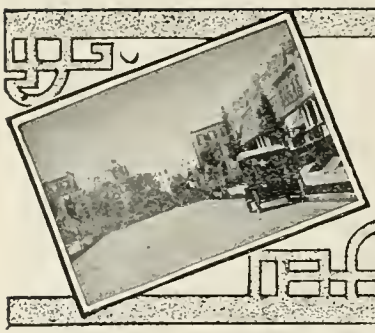
Commissioner Edgerton, commenting informally on the matter at the hearing, suggested that there is at least a sentimental element of advantage in an underlying bond, and that holders of the underlying 5 per cents might not be willing to relinquish them for a general mortgage bond, unless there was some cash inducement, an dthat "if a reasonable amount is paid to get rid of the underlying securities, it is a burden that the public may very well pay for the advantage of obtaining the extensions. The question of what is a reasonable amount is a subject for consideration."

Lighting the Lincoln Highway

Aurora, Rockford, Joliet and other Illinois cities are placing lights along the route of the Lincoln highway within the city limits, the automobile clubs usually supplying either the lights or the special globes, which are square, with red, white and blue bands, and the letter L in the middle.

Gas-Lighting Tests at Montevideo

A test is now being made of lighting the port of Montevideo with high-pressure incandescent gas lamps. A trial installation of four Keith lamps, each of 3,000 candlepower, has been put up by the Montevideo Gas Co. These lamps, which are hung on iron columns some 20 feet high and placed along the asphalt way leading to Mole A, have two mantles each and are lighted by gas at a pressure of 2,030 to 2,540 millimeters of water. The mantles are inclosed in separate coverings of silica, which, besides having the advantage of being small, are not subject to damage or breakage, even if they become wet. The arrangement for giving the necessary pressure to the gas is simple. The gas is supplied from the street mains.



MISCELLANEOUS

Trade Sentiment in South America

Frank Lamkin, in a recent press letter says that he spent the past year traveling thru the leading countries of South America, in his capacity of export manager for ten American concerns. He finds that American manufacturers have the keenest possible interest in conditions prevailing in the southern continent. He says:

Only a man who has spent much time on the ground can appreciate the nature of the opportunities, or for that matter the silliness of many things written and said about selling conditions prevailing among our South American neighbors. What I write here is based on my own personal experience and observation. It is vital that Americans begin right in order to take the quickest and best advantage of the markets that are now laid open.

I have visited one of the largest buyers in South America, six times, on as many different trips thru Latin-America, and each time failed to get his order.

Last April I again called on this buyer, and to my surprise and delight, after a thirty-minutes' conversation, he asked my advice as to what would constitute a comprehensive stock of the merchandise I represented. My recommendations were accepted and an order given the following day.

After concluding the business, I asked him why he had decided on changing his policy toward American-made products.

"Well, I have got a premonition. It has been growing for a year, in fact, ever since your last call on me. I believe that eventually South America will get the bulk of its imports from the United States, and we are just about ready to make our change. I am credited with being a trifle more progressive than other dealers in this market, and this may account for my making a start earlier than the rest."

This incident fairly illustrates the situation thruout South America, and this apparent development of a sixth sense impressed the writer from the very first month of a year's trip just completed, that carried him thru all the principal Latin-American trade centers.

Sentiment toward the United States appeared changing, and while the efforts of the English and German business houses and newspapers have been actively directed to creating and maintaining a feeling of distrust toward American policies, products and business, the effort has not been entirely unfavorable to us. The manifestly fair attitude of our government toward Mexico, during the recent crisis, did much to assist the tide of sentiment favoring this country, and answered, effectively, many arguments advanced against us by the European representatives.

The trade visited was more inclined to consider the formation of business connections with American manufacturers and jobbers than on any of my previous trips. Native business men were disposed to place sample orders.

The Buffalo Brick Convention

The annual meeting of the National Paving Brick Manufacturers' Association in Buffalo on September 9 was followed in the evening of the same day by a conference with the sub-committee on standard brick pavement specifications of the American Society of Municipal Improvements and by two trips of inspection of brick street and road pavements in the vicinity of Buffalo on the two following days, on which the members of the association were accompanied by some two hundred of their invited guests. These guests were largely city, county and state engineers and members of their executive boards, with some representatives of the technical and trade press and of engineering schools.

The association has had a prosperous year, the brick manufacturers having had the greatest volume of business in their history. Its educational work and its work in promotion of the use of brick as paving material have maintained the high standing of the past, and there has been a material increase in membership, with no losses. The new members admitted at the convention are the Brick and Stone Co. of Waynesburg, Pa., Paul Beer. Des

Moines, Ia.; Carlyle Paving Brick Co., Portsmouth, O., and Lincoln Paving Brick Co., Canton, O.

The president again made his recommendation of the employment of one or more association engineers to use in educational work among city officials and others. The secretary's report shows the varied activities of the association from preparation of specifications and inspection of the work done by them to the issue of a periodical entitled *Dependable Highways*, leaving no avenue of presentation of the advantages of brick paving untraveled.

During the year the association has issued a new booklet of specifications with some modifications and improvements of former sets. This set of specifications was discussed with the members of the sub-committee of the A. S. M. I. who were present, E. H. Christ, chairman, Henry Maetzel, F. J. Cellarius and J. A. Vanderwater. It is probable that most of the changes discussed will be adopted by the committee and presented to the A. S. M. I. One important question which was thoroly discussed and upon which agreement was reached is factory mended, to be optional with the city, and not to prevent inspection on the street. Another question, on which agreement was not reached, was that of the method of selecting samples to subject to the abrasion test. This is a question on which the experts are not agreed and the conference referred it to them for answer after further experiment and discussion.

The banquet on Thursday night under the leadership of George C. Diehl, of Buffalo, was very enjoyable. The speeches included representatives of the state and county highway engineers and city engineers, the A. S. M. I., the engineering press and the technical schools.

The inspection trip on Thursday included highways in Erie county, most of them built by the State Highway Commission or under their supervision.

The oldest brick roads traveled over were about four years old and all were in excellent condition, the few defective areas being due to bad foundations, unauthorized use of culled brick, poor design and construction of transverse joints, the pavements having no transverse joints showing no such defects. Some crushing of filler and deterioration of joints was noted on curves, however, indicating that there should be some method of relieving the curves of the pressure from longitudinal expansion on the tan-

BRICK ROAD *under construction in Erie County, New York. Sand cushion prepared and men laying brick.*

CULLING BRICK *prior to rolling. Visitors inspecting the process and result. This is an important stage in the process of making a good street. Much depends on the judgment of the inspector.*

gents. The division engineer attributes 70 per cent. of the defects in brick pavements to poor foundations and 30 per cent. to poor grouting, those from other causes being too small in proportion to take account of.

The large amount of wire-cut-lug blocks in use was very noticeable, the excellent results with the early pavements, laid in 1910 with this form leading to their general use in later work. The work observed under construction was being laid with the wire-cut-lug blocks.

The two accompanying photographs show the preparation of the sand cushion and the inspection by the visitors of the brick laying and brick in place ready for rolling on the part of the Lake Shore drive under construction.

The guests of the association were hearty and profuse in their expressions of satisfaction with the results of the conferences and inspections and much excellent educational work was done along the lines upon which manufacturers' and engineers' organizations are working together in securing more uniform qualities of materials and better methods of construction.

American Road Builders' Convention

The program committee of the American Road Builders' Association reports that plans for the eleventh annual convention, to be held as the American Good Roads Congress, in the International Amphitheater, Chicago, December 14 to 18, are near completion.

Monday afternoon and evening will be devoted to registration and the sessions will begin on Tuesday. The sixth good roads show will be formally opened at 7:30 p. m. Monday.

In the forenoon of Tuesday will be held committee and other preliminary business meetings. At 2:30 p. m. the congress will be opened by President W. A. McLean and addresses of welcome by officials of Chicago and Illinois, and Illinois organizations interested in good roads.

The technical sessions will commence on Wednesday and will be held each morning and afternoon. On Wednesday evening, the association will hold its annual dinner.

Among the topics to be treated under the general classifications of organization, construction and maintenance are "Road and Pavement Dimensions—Widths, Depths and Crown;" "Road Foundations—Concrete, Telford, Gravel, etc.;" "Organization:" "Traffic—Present Tendencies, Probable Development and Regulation: "Machinery for Construction

and Maintenance;" "Brick Roads and streets;" "Surface of Floors for Bridges;" "Bituminous Construction and Maintenance — Recent Practice;" "Concrete Roads;" "Recent Practice in the Construction of Wood and Granite Block Pavements;" "Earth and Gravel Road Construction;" "Street Paving in Small Cities;" "Convict Labor in Road Construction," and "Dust Prevention and Street Cleaning."

On Thursday evening a popular session will be held with speakers of national prominence.

The exhibition feature promises to excel in extent and importance the exhibition of last year.

Exhibit of Street Cleaning, Refuse Collection and Refuse Disposal Appliances in New York

The Department of Street Cleaning of the City of New York proposes to hold an exhibition of street cleaning appliances during the week beginning November 23, 1914, at Recreation Pier, foot of 24th street and East River, Boro of Manhattan, New York City. The purpose of this exhibition is threefold. (1) To show the people of the City of New York the types of equipment now in service. (2) To give manufacturers of modern street cleaning apparatus an opportunity of exhibiting their various appliances, not only to the citizens of New York, but also to officials of surrounding communities who will be invited to attend. (3) To provide an opportunity for practical tests or demonstrations of street cleaning appliances under such conditions as will be acceptable to the city and manufacturers.

The street cleaning apparatus proposed for exhibition will cover all sorts of brooms, brushes, sweeping machines, flushing machines and other equipment or appliances used in cleaning streets and removing snow; garbage, ash and rubbish cans or receptables used by householders; carts, wagons, motor trucks or other vehicles used for collecting garbage, ashes, rubbish and street sweepings; conveyances for transporting refuse by water or by rail; methods used for the disposal of garbage, ashes, rubbish and street sweepings, including garbage reduction works, garbage crematories, incinerators, destructors, etc.

Minneapolis Discounts Its Bills

Upon receipt of any proper bill or invoice for goods, materials or merchandise purchased by the city (not including Library Board, Board of Education, Park Board and Board of Charities and Corrections) upon which a discount is allowed for prompt payment, the Purchasing Agent transmits the same to the head of the department for whose use the purchase was made, for approval and audit and prompt return. The Purchasing Agent adds his approval thereto and delivers invoice to City Comptroller for payment.

The Comptroller arranges with the City Treasurer for the immediate payment of the net amount of such bill, by Treasurer's check drawn on any bank in which city funds are deposited, which check, with the bill is delivered to the Comptroller who in turn delivers the check to the person entitled thereto. The Treasurer is reimbursed by a check warrant drawn upon the proper fund. A number of advance payments may be reimbursed by one check-warrant.

Failure or neglect on the part of heads of departments, whereby the city suffers the loss of a discount agreed upon for prompt payment, constitutes a misdemeanor, punishable as such upon correction.

The discount system was adopted and the first bill discounted on January 29, 1914. During the first three months 2,435 bills, subject to discount, were paid, amounting to $139,157.43, on which the discount was $2,199.58 or an average of 1.6 per cent. This is certainly worth saving when it is merely a matter of hastening the issue of the check by prompt passage of the bill thru the regular channels to payment.

Technical Associations

The Northwestern Road Congress will be held in Milwaukee, Oct. 28 to 31. More than thirty papers are on the program by state highway commissioners, U. S. road experts, governors and others. The States of Iowa and Wisconsin, and the city of Milwaukee will make exhibits, also Milwaukee county, showing its 100 miles of concrete roads, and the U. S. Office of Public Roads.

The Society for Electrical Development is sending out to manufacturers a letter on the South American market which should interest them and induce them to avail themselves of the aid which the society offers in the way of information, services in translation of circulars and catalogs for foreign distribution, and the like. J. M. Wakeman is general manager, 29 W. 39th St., New York.

The American Society of Municipal Improvements, meeting at Boston, Oct. 6-9, issued the best advance program offered for some years.

The Kansas League of Municipalities meets in Lawrence, Oct. 7-9.

The Minnesota League of Municipalities meets in Mankato, Oct. 21-22.

The California League of Municipalities will meet in Monterey, Oct. 12.

The American Highway Association holds its annual Road Congress in Atlanta, Ga., Nov. 9-14. Charles P. Light, business manager, Colorado Bldg., Washington, D. C.

The Conference of American Mayors for the Discussion of Utility Problems meets in Philadelphia, Nov. 12-14. Clyde L. King, acting director, 216 City Hall, Philadelphia, Pa.

The National Municipal League meets in Baltimore, Nov. 17-21. Clinton Rogers Woodruff, secretary, North American Bldg., Philadelphia, Pa.

The American Public Health Association meets in Jacksonville, Fla., Nov. 30-Dec. 5. S. M. Gunn, secretary, Mass. Inst. of Technology, Boston, Mass.

The Illuminating Engineering Society will meet in Cleveland, O., Sept. 21 to 25. A very interesting and instructive program has been prepared.

Technical Schools

Fred E. Ayer, dean of the college of engineering of the Municipal University of Akron, O., has prepared a report of an investigation of the pavements of Akron by the Municipal University, made in accordance with a resolution of the city council, which considers the conditions and difficulties and to some extent the result thereof. It also contains a report on the standard city form of contract and specifications, prepared by the New York Bureau of Municipal Research, with detailed criticisms of the same.

The announcements of the School of Commerce, Accounts and Finance for 1914-5, day and evening sessions, are contained in the New York University Bulletin of June 26, 1914.

Indiana University Extension Division has published a report of the conference on the question of the calling of a constitutional convention in Indiana, which was held at Bloomington, Ind., in June, 1914. It contains a valuable series of papers and discussions on constitutional questions and can be obtained from the University Bookstore for 25 cents.

Roger DeLand French, lecturer in municipal engineering at McGill University, Montreal, Que., wishes to receive catalogues and other literature from manufacturers of sewer pipe, steel sheet piling, castings, trenching machinery, etc., and all other apparatus and supplies used in sewer construction. These are for use in the course in municipal engineering at McGill University.

Civil Service Examinations

The U. S. Civil Service Commission will held examinations at the usual places as follows:

Oct. 7-8: Torpedo Engineer in Naval Torpedo Station, Newport, R. I., at $9.60 a day; 12 clerk-draftsmen in six surveyors-general offices in western states, at $1,200 a year.

Publications Received

The Exposition Fact Book of the San Francisco Exposition and a very handsomely illustrated booklet on "The Thirteenth Labor of Hercules," are issued and can be obtained by addressing the Panama-Pacific International Exposition Co., San Francisco. They are well worth the trouble of sending for them for beauty as well as information about the exposition and methods and cost of getting to it and seeing it.

The proceedings of the second annual meeting of the Montana Institute of Municipal Engineers contain several papers on municipal improvement. C. C. Widener, Bozeman, Mont., is secretary.

Proceedings of the ninth convention of the Nebraska Cement Users' Association, paper, 96 pp. Frank Whipperman, secretary, 28th Ave. and Sabler St., Omaha, Neb.

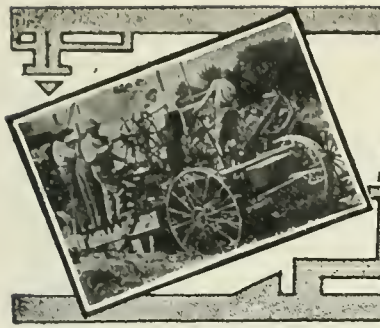
The official publication of the Illinois state highway department is called "Illinois Highways, was begun in April and is issued monthly by the department at Springfield.

The new catalog of the Rock Island Bridge and Iron Works, Rock Island, Ill., is largely devoted to steel towers and tanks but also shows their work in steel barges, structural and ornamental steel work, staircases, fire escapes, derricks, bridges, bins, etc.

Solvay Hydraulic Paint is the subject of a brief circular issued by the Semet-Solvay Company, New York and Chicago.

The August number of *Dependable Highways* is the first of the new publication to be distributed monthly by the National Paving Brick Manufacturers' Association to municipal officials, engineers, highway commissioners, contractors, manufacturers of brick and other clay products, clay working machinery and supplies, automobile clubs, civic and neighborhood clubs and the general public interested in better highway conditions. If not now on the list, ask for it from the secretary, Will P. Blair, B. L. E. Bldg., Cleveland, O.

The fall number of *The Koehring Mixer* is issued and contains information about the fall and winter exhibitions and a large picture of the mixer in use on Milwaukee county roads. It is issued by the Koehring Machine Co., Milwaukee, Wis.



MACHINERY AND SUPPLIES

Bermudez Road Asphalt

Five years of experience with Bermudez road asphalt in asphaltic macadam roads constructed by the penetration and mixing methods have demonstrated the durability of this material for this use, as it had already been demonstrated for use in asphalt pavements.

The purpose of asphalt in a road is to act as a cement to hold together the stone and other mineral aggregate. This makes it evident that the life of the road is dependent upon the continued cementing power of the asphalt. If it bleeds, cokes, volatilizes, loses its adhesive qualities and its ductility, the roadway will soon go to pieces.

Bermudez road asphalt is made of material of stable qualities from the famous Bermudez asphalt lake in Venezuela.

The conspicuous successes in road building that have been achieved by the use of Bermudez road asphalt in all sections of the United States and in Canada include roads constructed both by the mixing (asphaltic concrete) and penetration (asphaltic macadam) processes. In the former method the material is mixed hot with sand and stone, the mixture being then placed on a suitable foundation and rolled to absolute compaction.

Penetration roads are constructed by placing the stone on the roadbed in very much the same manner that is followed in the construction of an ordinary macadam road. Hot asphalt to the amount of about 1¾ gallons per square yard is then poured upon the stone, and after rolling a seal coat is applied, over which fine screenings are placed and the road again rolled.

No question whatever is raised as to the merits of the mixing method of construction, but doubt has been expressed in some quarters as to the desirability of penetration roads. This doubt is due to experience with penetration roads that were poorly constructed with poor materials. Penetration highways built in New York State and elsewhere in 1909-10 are in almost perfect condition today, in spite of the fact that they have received practically no maintenance whatever.

There are more than 12,000,000 square yards of Bermudez asphalt highways now in existence that have been constructed since 1909. This yardage, which is equivalent to 1,32. miles of 15-foot roadway, is to be found in all sections of the United States from Wisconsin to Florida, from Colorado to Massachusetts. It includes park drives, city boulevards and town streets as well as country roads. It comprises both asphaltic concrete and asphaltic macadam with broken stone and gravel. It includes the resurfacing of old macadam, brick pavements and shell roads, and construction of Portland cement concrete base, as well as the resurfacing of cement concrete roads.

Economy in Truck Tires

A little study and inspection of the Goodyear S. V. truck tire seems to indicate that in designing the tire the feature most sought for was economy to the truck owner.

The first and most noticeable item is the total absence of steel fastenings of any kind. The first cost on fastenings for a truck tire of the demountable type ranges from $3.00 to $7.00 per wheel, and on the old-style pressed-on type, the supplemental band may cost from $3.00 to $9.00 per wheel. Taking the most popular size tires, this charge for steel equipment represents about 10 per cent. of the total cost of the tire, or, in other words, the purchase of an S. V. tire can be considered as a 10 per cent. reduction in price.

When one considers that the figures given above represent a saving on only one wheel, it can easily be estimated what it will amount to on a whole truck, or, to make it even greater, on a fleet of trucks.

To go beyong the first cost figures, there is found to be an even greater economy than is at first apparent. We refer to weight. The weight of the steel fastenings in the case of a demountable

type tire, or the weight of the supplemental band in the old-style pressed-on tire, is great enough to represent an additional yearly expense of well over a hundred dollars when the cost of carrying it around is estimated at 15 cents per ton mile. The economy idea is further driven home by the fact that the additional weight referred to is not borne by the springs.

These are only a few of the points of economy in the Goodyear S. V. tire, but they are sufficient to represent quite an item in the truck owner's upkeep for the year.

Medusa Cement In Building Construction

The greatest improvement in the way of new buildings that has been made in Cedar Rapids during the past year took place at the Quaker Oats plant, where nearly a round million of dollars was expended in new buildings alone. Already the largest oat meal and cereal plant in the world, the improvements this year have enlarged the big institution until the local plant now has more than double the capacity of any other similar plant in the entire world.

Some idea of the immensity of the buildings may be gained from the fact that one of the new buildings alone—the Corn Puffs structure—has 211,000 square feet of floor space, or only 9,000 feet less than five acres of space in the one building. From D avenue to the alley at B avenue there is 520 feet of solid building, containing almost ten acres of floor space. In addition to this the new eight story building on the east side of Third street contains 120,000 square feet of floor space, and is now almost completed. The new elevator and grain tanks south of B avenue have a capacity of 800,000 bushels of grain, making the total storage capacity at the plant 2,000,000 bushels.

Another idea of the size of the plant may be had from the fact that when the additional machinery is installed and running, the mill will turn out 7,500 barrels of oat meal and other cereals every day, in addition to 75 car loads of stock food. To the ordinary individual it is hard to understand where this gigantic output goes, but when it is understood that the entire world is the market for Quaker Oats, puffed rice, wheat and corn the amount is not so large after all.

Warehouse No. 6, shown in the photograph, is 120x160 feet, ten stories and basement of reinforced concrete skeleton construction of the cantilever flat slab type. All floors were designed for a live load of 200 pounds per square foot with panels 20 feet square. A 75,000 gallon steel tank has been built above the roof to supply the sprinkler system for the entire plant.

Thirty thousand barrels of Medusa

REINFORCED CONCRETE WAREHOUSE *of Quaker Oats Company. Cedar Rapids, Iowa.*

PANAMA-CALIFORNIA EXPOSITION *at San Diego. A section of the grounds with the fire station in the background.*

portland cement, made by the Sandusky Portland Cement Co., were used in Warehouses No. 6 and No. 2.

Panama-California Exposition at San Diego

The park in which the Panama-California Exposition is set contains 1,400 acres, 615 of which are used by the exposition. With all this territory, it was possible to carry out the Spanish idea—using low, graceful buildings connected by arcades, with arched cloisters along the plazas and the Prado and about the quiet, flower-filled patios within the mission walls. The buildings are not crammed together, but open up here and there with vistas of broad lawns extending down to the canyons at the edge of the mesa, with glades of shrubbery and an occasional pergola. And as long as there was on hand a climate which knows frost as little as it knows torrid heat, thanks to the equalizing influence of the steady sea breeze at that southernmost tip of Uncle Sam's Pacific slope, San Diego took advantage of climate to place as many exhibits as possible out-of-doors. There are five days a year, on an average, when the sun does not shine in San Diego. What this arrangement means to fire protection is apparent.

The accompanying photograph gives a view of some of the garden and orchard space with the fire station near the center. This station has a full equipment of Seagrave motor fire apparatus and is ready for business during construction, and installation of exhibits, as well as during the exposition itself.

The Sand Blast

A paper by H. D. Gates before the Associated Foundry Foremen of New York and Vicinity, giving valuable practical points on the selection and operation of sand blast equipment from the user's viewpoint is distributed by the De la Vergne Machine Co., New York, and can be obtained for the asking.

The paper describes the apparatus and the many uses to which it is put, and gives tables of flow of air, figures of cost of work, etc., and is of interest to any engineer, especially in pointing out the uses which can be made of the apparatus.

Information About Asphalt Pavements

One of the handsomest booklets received is one entitled "Evidence" on the handsomely illuminated cover, which is amplified on the title page to read "A Volume of Evidence as to the Durability of Lake Asphalt Pavements." It is issued by the Barber Asphalt Paving Co.,

Philadelphia, Pa., and contains a very remarkable collection of facts, both figures and photographs, as to the durability and economy of Trinidad and Bermudez Lake asphalts from many cities in this country.

Some of the information has been published in MUNICIPAL ENGINEERING, but it is convenient to have as much of it collected into one booklet, so that it can easily be found and compared.

Copies will be sent by the company on request.

Specifications for Street Cleaning Machine

The squeegee street cleaning machine consists of a four-wheeled gear with platform springs on front wheels. It can be arranged with pole for two-horse team or shafts for three-horse team.

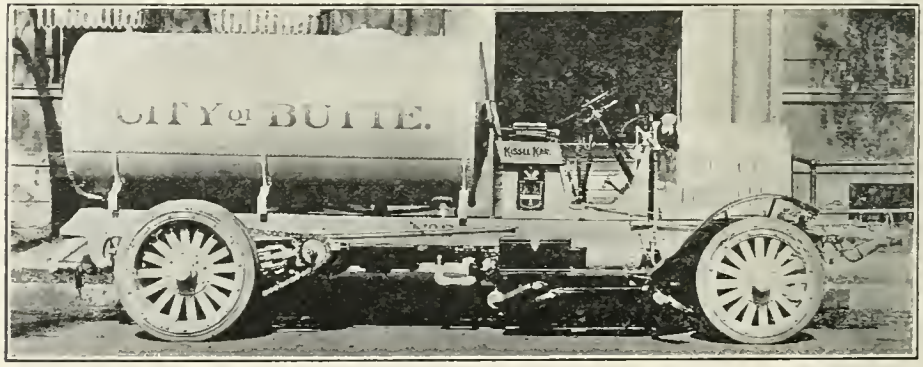
A heavy sheet iron circular shaped tank is mounted on springs on rear axle, with front of tank resting on the springs of front axle. A suitable driver's seat is placed on top of tank.

The tank has a capacity of 500 gallons of water. The water is delivered thru four perforated sprinkling pipes located between the front and rear wheels.

Directly back of the rear wheels and suspended from and at an angle to the rear axle is a spiral revolving rubber brush driven by gearing connected to wheel on rear axle. This brush can be removed from the surface by the driver from his seat.

The machine is furnished complete, including painting ready for operation. The weight of the outfit is approximately 3,350 pounds without water.

It is made by the Kindling Machinery Co., Milwaukee, Wis.



STREET FLUSHER AND SPRINKLER *of the city of Butte, Mont.*

TAR *in these barrels removed from sewer by turbine sewer cleaner.*

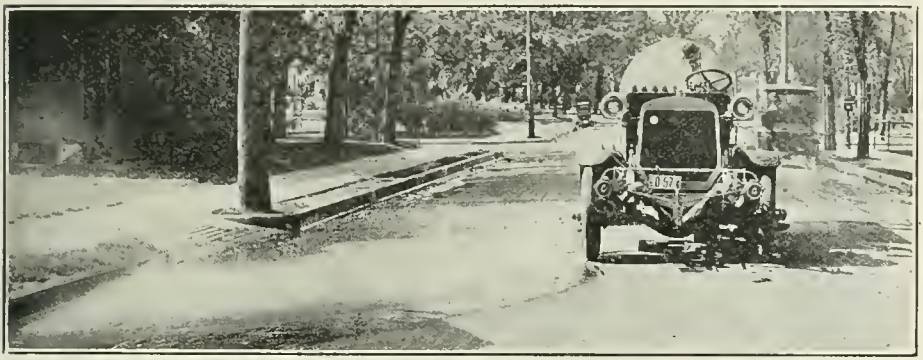
Tar Removed From A Sewer

The accompanying photograph shows a few of the fifty or more barrels of tar taken out of a sewer in Fond du Lac, Wis., with a turbine sewer cleaning machine made by the Turbine Sewer Machine Renovating Co., of Milwaukee, Wis. In some places the tar from the gas plant had accumulated 10 to 12 inches deep in a 24-inch sewer. The tar was distributed thru about 3,000 feet of sewer, but most of it was in the middle 1,000 feet.

Motor Street Sprinkler and Flusher

The accompanying photographs show the KisselKar combination street sprinkler and flusher.

The first photograph shows one owned by the city of Butte, Mont., in which can be seen the 1,000-gal. galvanized steel tank, mounted on a regular 3½-ton chassis. The water runs by gravity to a 2-stage centrifugal pump directly connected to the motor, and can be delivered at 20 to 60 pounds pressure according to the speed of the motor, the same pressure being available as long as there is any



COMBINATION STREET FLUSHER AND SPRINKLER. *One view shows the sprinkler heads in action, the other one of the flusher nozzles in operation.*

water in the tank. The pump supplies water to the sprinkler heads seen, with the connecting piping at the right in front of the car, or to the flushing nozzles, with flat delivery orifices, one of which is seen near the pavement immediately in the rear of the front wheel. The levers for operating the valves may be seen on the dash at the driver's right and the water can be turned from sprinkler to flusher in an instant by shifting a lever.

The sprinkler can sprinkle a 60-foot street from curb to curb or it can be shut down to cover any less width on either or both sides as the traffic passing or vehicles standing may require.

One tank of water will sprinkle 7 to 8 blocks of 50-foot roadway, or will flush a distance of 3½ blocks.

Two of the pictures give front views of the sprinklers operating on a rather narrow roadway and of the operation of the flushing nozzle on one side of the car on the same street. The uniform distribution of the water by the sprinklers is notable. The angle of the water from the flusher can be changed as may be desirable.

Full information about this useful piece of street cleaning apparatus can be obtained of the Kissel Motor Car Co., 554 Kissel avenue, Hartford, Wis., and from their numerous branches and representatives in all important cities.

A New Water Works Directory

The last edition of the Manual of American Water Works published by the Engineering News Co., was issued in 1897. Since that time there has been no publication to cover the field. The McGraw Publishing Co. now proposes to publish "The McGraw Water Works Directory," which for $15 will give in its 375 pages the usual data desired concerning water works, such as city, population, ownership, names of superintendent, purchasing agent, plant engineer, source of water supply, method of supply, equipment of plant, hydrants, tanks, meters, boilers, engines, etc. It will contain suitable summaries by states, indexes and whatever will be found of value to purchasers.

In conjunction with this book will be published "The Water Works Buyers' Guide and Reference Manual, which will combine with a handbook of working data, diagrams, charts, etc., a buyers' guide showing names of addresses of manufacturing concerns supplying the needs of water works men. A copy of this book

will be sent to every water works engineer and superintendent co-operating in supplying information for the Directory.

Water works men who have not received the information blanks from the McGraw Publishing Co., 239 West 39th street, New York, should send for them at once.

The books will be issued early in 1915.

Buy A Bale of Cotton

The Goodyear Tire & Rubber Company is the first of the tire companies to take up the "buy a bale of cotton" movement by which an effort is being made to move at least a part of the South's enormous cotton crop this year. Instructions have been issued to the managers of Goodyear's eight branches in the cotton belt to buy bales of cotton and to place them in the branch show windows. Each bale bears the name and address of the planter from whom it has been purchased, and in addition an exhortation to others to do likewise.

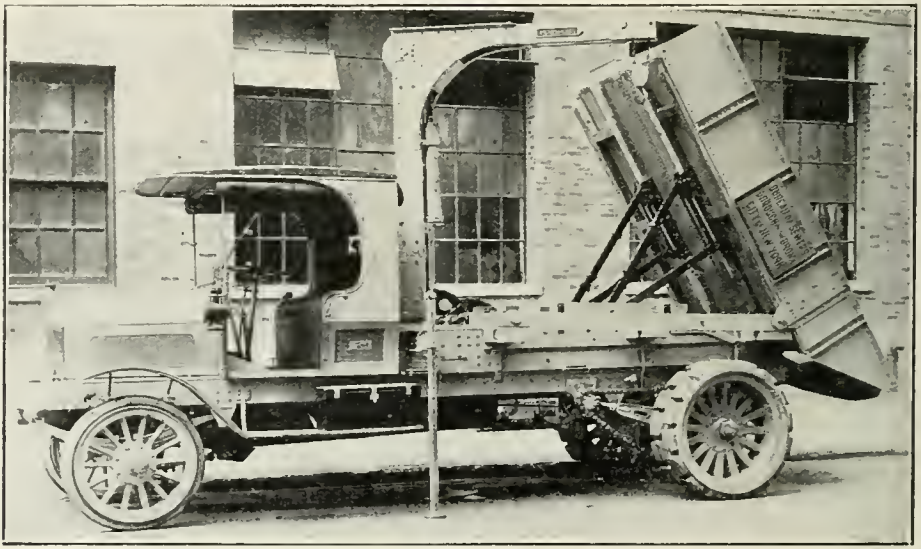
"The present situation, due to the accumulation of such a large crop with no means of selling it, may yet prove of value to Southern farmers," says a Goodyear official, who has just returned from the South. "Too much reliance has been placed by farmers on one, or at best two, staple crops. When these fail, or when they cannot be turned into cash, the farmers are left helpless. Many of them buy almost all their food products. This condition is likely to be changed as a result of this year's experience. More diversified crops and more scientific tilling is already being urged, and Northern farmers and their ideas are now more welcome in the South than ever before."

Motor Truck for Sewer Cleaning Gang

The accompanying photograph shows a 7½-ton Mack dump truck of the Bureau of Sewers, boro of the Bronx, New York, equipped with a motor-operated crane for lifting buckets of sediment from sewer manholes and depositing contents in the body of the truck. The design of this equipment is original.

Heretofore it has been necessary for a gang of men to laboriously haul a small bucket of refuse from sewer manholes by hand process, or else use a tripod derrick, which only slightly aided matters. With this truck it is possible to run the truck alongside the curb, and, with the swinging crane, raise a bucket of silt weighing 1½ tons above the sides of the body and dump it on board.

The truck has a special steel watertight dump body, with a capacity of 3½ cubic yards. The body is equipped with the Hunt dumping device. As the material to be dumped is of a quality which offers considerable resistance to gravity, the body is raised to an angle of 60 degrees.



MOTOR DUMP WAGON *for sewer gang. Note crane for lifting buckets and dumping them in the water-tight bed, here shown tipped for dumping and exhibiting the dumping apparatus.*

The hoist is manufactured by the Brown Hoisting Machinery Company, Cleveland, and consists of an upright about 8 feet above the floor of the truck, with an arm extending out, which gives the crane an effective radius of 8 feet. This crane is operated from the clutch shaft and controlled by a lever which is directly behind the cab, within easy reach of the driver. It is possible to rotate the crane by hand so that material can be picked up from either side of the truck. The crane rotates from 200 to 220 degrees. With the propeller shaft revolving at 600 the crane has an effective hoist speed of 20 feet per minute.

Wheel base of the truck is 14 feet 6 inches; front wheels, 36 inches, equipped with 36 by 6-inch Goodyear tires; rear wheels, 42 inches, equipped with 42 by 7-inch dual Goodyear tires. The motor is a 50-h.p. Mack.

A Pocket Slide Rule

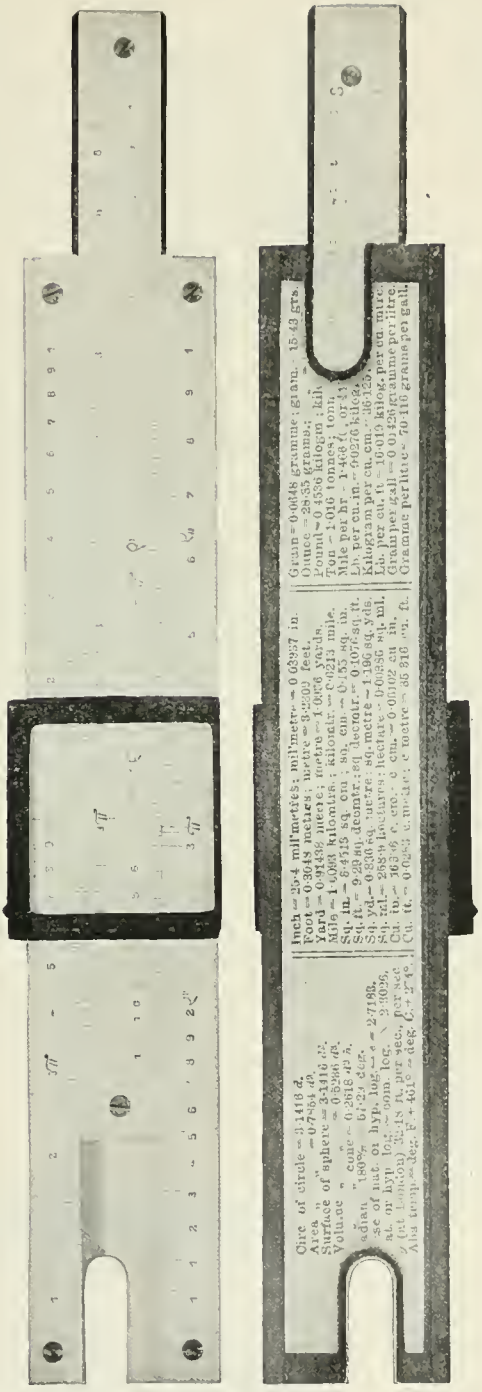
The accompanying cuts show full size the two sides of a 5-inch pocket slide rule which can be purchased of Clark T. Henderson, Box 1564, Milwaukee, Wis. Mr. Henderson began by using the rule himself and found it so convenient that he imported them for his friends and now finds himself obliged to keep it on hand in stock sufficient to meet the many inquiries for it from those who have seen it in use. A light case contains it and it is of convenient size for the pocket. Mr. Henderson will give any particulars not shown in the cuts.

Expert On Sewage Disposal

Mr. H. D. Wyllie, who has for the past fifteen years been connected with the Cameron Septic Tank Company as consulting engineer, is now in position to offer to city engineers and municipal officials a unique co-operative service which should be in demand thruout the country.

Sewage disposal involves problems which only one trained in a thoro knowledge of the subject can solve. These problems concern not only design and installation of plants, but their operation as well. Many properly designed plants have been unsatisfactory because of improper operation. Sewage disposal is a special branch of sanitary engineering which has become an important and prominent one. Many engineers have hesitated to enter this field because of a lack of information regarding the technical details and many who have attempted to give attention to it have become discouraged after a few costly failures.

Mr. Wyllie is one of the few specialists who are thoroly equipped by training and by experience to meet every requirement



TWO SIDES OF POCKET SLIDE RULE, *one of the necessary conveniences for ready computations.*

incident to the design, construction and operation of disposal plants. The hundreds of installations made under his direction in the past decade or more have demonstrated many important principles, among which are the now recognized efficiency and economy of the septic process both in first cost and in operation. His plan contemplates not only the design and construction of plants, but also a comprehensive course of practical instruction for engineers or officials who may be called upon to operate them. Mr. Wyllie's new offices are located in the Monadnock Block, Chicago.

Combination Pocket Rule and Level

This article is a 2-foot folding boxwood rule, fitted with a spirit level. The three 8-inch rule sections are each 1 inch wide, 3/16 inch thick and united by substantial brass joints. The rule is fully graduated entire length both sides, one side inches to eighths, other side to sixteenths. The spirit level is neatly set into and flush with the upper edge of the middle section of the rule, where most convenient for use, and securely protected by the two outer sections of the rule, which fold against it on either side when closed for carrying in the pocket. The combination rule and level, being light and but 8 inches long when folded, is conveniently carried in the pocket. Closing pins especially designed for the purpose hold the sections of the rule in proper alignment, insuring a perfect bearing surface.

The accuracy of the rule and level is guaranteed. The article is new in every sense of the word, and, both as rule and level, a practical tool. The Lufkin Rule Company, of Saginaw, Mich., are its manufacturers and patents are pending.

TWO VIEWS *showing the combination pocket level and rule, closed, and open to show the grooves into which the level tube fits.*

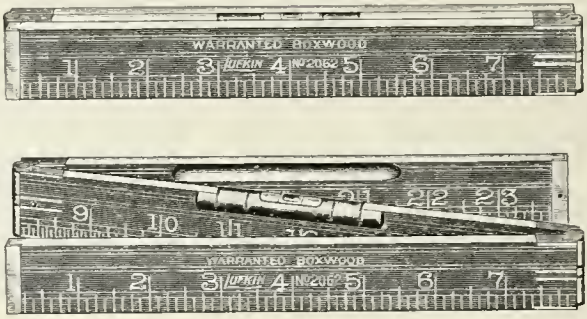
Trade Notes

Among recent contracts awarded to the Raymond Concrete Pile Co. are concrete piles for foundations of the Austin-Nichols Co., Service building, and two thirteen-story apartment houses at Broadway, 84th street and West End avenue., New York; foundations of factory building for the Fifty Associates Co., Toledo, O., and foundation of the Y. M. C. A. building, Canton, O.

The Detroit Sanitary Closet Co., Detroit, Mich., is introducing the sani-spray" apparatus for flushing the seat of a water closet as well as the closet itself, which has a rubber wiper bar to remove surplus water when the cover is lifted.

W. H. Stewart, the manufacturer of sewer rods and a sewer cleaning machine, is now located at 415 Dorchester avenue, Boston, Mass.

Contracts for the concrete pile foundations of the following structures have been awarded to the MacArthur Concrete Pile & Foundation Co.: Grain bins and elevator, Stanard Tilton Milling Co., Alton, Ill.; bakery for Ward Baking Co., East Orange, N. J.; weave shed, Salt's Textile Manufacturing Co., Bridgeport, Conn.; the Portland (Maine) Gas Light Co. will erect a 1,500,000 cubic foot gas holder. The foundation consisting of 576 pedestal concrete piles and a 12-inch concrete mat.



MUNICIPAL ENGINEERING

The World's Leading Municipal Publication.

WOOD BLOCK PAVING ON HEAVY TRAFFIC BUSINESS STREET.

VOL. XLVII. NOVEMBER, 1914. NO. 5.

I'm now arrivcd—thanks to the gods!—
Thru pathways rough and muddy,
A certain sign that makin' roads
Is no' this people's study;
Altho I'm not wi' Scripture cram'd,
I'm sure the Bible says
That heedless sinners shall be damn'd
Unless they mend their ways.

—ROBERT BURNS.

Published by

Engineering Publishing Co.
INDIANAPOLIS, IND.

New York Office:
1127 World Bldg.
GEO. H. CLINGAN,
Eastern Mgr.

Chicago Office:
1634 Marquette Bldg.
E. D. POWELL,
Western Mgr.

Entered at Postoffice, Indianapolis, as Second-Class Matter.

A. P. Fox, President. **C. C. Brown, Editor.** **C. S. Sale, Gen'l Mgr.**

Subscription Price in U. S. and Possessions, Cuba and Mexico, $2.00. Canada, $2.40. Foreign, $2.75.

Changes of address, subscriptions, remittances and editorial matter should be addressed to MUNICIPAL ENGINEERING, Indianapolis, Ind.

AMERICAN SOCIETY *of* MUNICIPAL IMPROVEMENTS

ABSTRACTS OF PAPERS PRESENTED AT THE OCTOBER CONVENTION AT BOSTON.

So many excellent papers were read at the convention of the American Society of Municipal Improvements that it is impossible to use them all or all of any considerable part of them in this number of MUNICIPAL ENGINEERING. *The selections made are grouped together and show the breadth of the field covered. All of the proceedings will appear in the annual volume published by the Society.*

Inflammable Wastes in Sewers.

By N. S. Sprague, Superintendent of Construction, Pittsburgh, Pa.

There have been many explosions in sewers in recent years, of but few of which definite information is available. Pittsburg has had its full share of serious troubles of this sort and the author has made a careful study of the subject. The results of his inquiries of other cities are given in a pamphlet printed by his department, and the application of the information gained to the problem of prevention of explosions is given in this paper.

THE author presents this paper with the hope of eliciting discussion upon this subject by those charged with the responsibility of the design, maintenance and operation of sewerage works, which may throw some light upon the ultimate solution of the problem of regulating the discharge of inflammable and explosive wastes into sewerage systems and preventing sewer explosions.

It is thought that some of the more recent and violent explosions were caused by the presence of gasoline vapor in the sewer and if this belief is accepted as a fact, then the advent of motor driven vehicles has created a problem in sewer design and maintenance which may prove difficult and expensive to solve. Sewer systems are generally looked upon by the average person as a quick and easy means of disposing of any or all waste matter which can be carried away by the sewer without any consideration whatsoever of the effect of such discharge, either upon the structure itself, its maintenance or operation. The transition in the mode of travel from horse-driven vehicles to the motor-driven car and truck, renders the transportation, handling and use of large quantities of gasoline necessary and it is inevitable that in the handling of this material some will be spilled or wasted, either by accident or design, which will find its way into the sewers.

There are many sources which contribute inflammable wastes in a greater

or less degree, ranging from the small and irregular discharges from households and private garages, which may amount to considerable in the aggregate, to the large and intermittent discharges from manufacturing and storage plants and other enterprises which use large quantities of gasoline.

In some cities (Pittsburg included), the laws relating to the storage of gasoline require the tanks to be buried in the ground. These tanks, which are made of riveted steel plates, vary in capacity from about 50 to 15,000 gallons. The purpose of placing them underground is to prevent possible ignition of the gas and protect them in case of a nearby fire. It is not the author's intention to discuss the advisability or the objection to placing gasoline storage tanks underground, but simply to point out the possible danger of gasoline escaping from these tanks and entering the sewers. The thickness of the steel plates of which the tanks are made, is generally from ⅛ to 3/16-inch and their only protection from corrosion is the application of ordinary structural paint. The tanks are laid directly upon the ground and then covered with earth. Under such conditions, corrosion is rapid. It is also possible, under favorable conditions, that the tanks may suffer injury due to electrolytic action. In any case, there is no opportunity for inspection or repairs and leaks can only be detected by making a comparison of the quantity of gasoline put into the tank with the quantity removed. This information is in the possession of the owners and in case a leak is disclosed by a comparison of the figures, the owners are not likely to volunteer the information to the public authorities.

¶ LEAKAGE *from underground sheet metal gasoline tanks is certain. That this leakage will reach near-by sewers is quite probable.*

The possibility of gasoline escaping from the tanks into the ground and finding its way into the sewers, may be remote, but with pervious soil or a near-by catch basin or trap, the opportunity for leakage into the sewers is at least present. In certain locations it is quite possible to set these tanks above ground, where ample opportunity for inspection and repairs would be possible. The waste gasoline from households, private garages and shops, is so well distributed thruout the lateral sewer system and the average amount discharged at any one time so small, that it is quickly dissipated before the formation of explosive vapors can occur. It is, therefore, to be supposed that the formation of gasoline vapor and other explosive gases present in sewers originates from establishments which are large users or dealers in inflammable materials.

There being in most cases no laws prohibiting the discharge of inflammable wastes into the sewers and the danger of such practice not generally understood, the natural disposition of such wastes is into the sewers. Those wastes comprise dirty and used gasoline, benzine, oil, washings from tanks, and refuse from gas plants, paint works, etc. The quantity of these waste products varies according to the magnitude of business and methods employed.

¶ WASTE PRODUCTS *of other kinds than gasoline may produce explosions and they must be regulated also.*

While the discharge of gasoline into the public sewers probably exceeds in quantity any other inflammable waste, yet the discharge of waste products from paint works, oil refineries, gas works, etc., is likely to produce conditions, which, under favorable circumstances, may fill the sewer with explosive gas. Ignition of explosive gases, when present in the sewers, may occur in many different ways—for instance: Sparks from street railway tracks, hot cinders and sparks from locomotives, stacks, etc., which may enter the manholes thru the perforations in the covers, or when same are removed for inspection or repairs; also the dropping of matches or lighted cigars into manholes or catch basins; lights and sparks from tools, while making inspection or repairs within the sewer or at chambers, pumping stations or disposal plants.

The problem of preventing sewer explo-

sions would then seem to be a question of either effectually sealing all openings into sewers or excluding or regulating the discharge of inflammable or explosive wastes.

A number of cities have attempted to solve the problem by procuring legislation prohibiting or regulating the discharge of inflammable waste materials into the sewers. Prior to the general use of motor vehicles there were many industrial and business establishments using inflammable and volatile wastes, such as dry cleaning establishments, paint manufactories, gas works, etc. Notwithstanding the fact, explosions in sewers caused by the ignition of gasoline vapor were uncommon. This fact would seem to indicate that the greatly increased use of gasoline due to the growth of the automobile industry has been responsible for many of the recent sewer explosions.

¶ CONTROL OF DISCHARGE *of gasoline into sewers is easy if from large sources, difficult if from many small sources.*

Accepting this theory as a working basis, we must determine whether or not the gasoline is discharging into the sewers in large quantities by a relatively few people or in small quantities by a great number. In the first case the situation is relatively easy to control, while in the latter, it would be difficult. Moreover, it is necessary and important to determine whether the explosive vapor is generated from the accumulative effect of a great number of small discharges or from the discharge of large doses. Past experience has shown that the ordinary means of providing ventilation in sewerage systems has been generally adequate to prevent the collection of explosive gases. If large doses of inflammable wastes are allowed to enter the sewers, other means of ventilation will have to be provided or the sewers sealed. The installation of mechanical ventilation in the sewers thruout the system would remove the gases, but would involve great initial outlay and the cost of maintenance and operation would generally be prohibitive. This scheme would not seem practicable. There is no practical way of providing sufficient ventilation, either by mechanical or natural means, which would exhaust the air inside the sewer quickly enough to prevent the formation of an explosive compound, in case large quantities of gasoline were present in the sewer. With the exclusion of large discharges of gasoline into the sewers, the danger of explosions can be greatly lessened by giving more attention to the improvement of the natural ventilation. This would probably be sufficient to prevent the collection of explosive vapors arising from the normal amount of gasoline discharged into the sewers. To form an explosive mixture a certain amount of air and gas is required. If there is a shortage of gas or an excess of air, no explosion can occur.

It cannot be ignored that many sewer explosions have resulted from the leakage of natural or artificial gas into the sewers. Evidence has been conclusive, in a sufficient number of cases, to show unmistakably that this is a fact. The prevention of explosions from this source, however, is well within the jurisdiction of public officials and the remedy is the tight construction of sewers and proper laying and location of gas pipes. The remedy in this case consists, therefore, is in the enforcement of powers that municipalities at present possess.

¶ VENTILATION *and inspection are aids, but so far have been insufficient to control the situation.*

Modern sewer design provides for the ventilation and inspection of the structure. The discharge of inflammable wastes into sewer systems would not of itself be a serious matter, or objectionable, were it not for the possibilities or igniting the explosive compounds. Ignition of gases in the sewers could be prevented by sealing all openings, but this would prevent inspection and create impossible working conditions inside the sewer when repairs became necessary. Moreover, the sealing of the sewers would not prevent ignition at chambers, pumping stations and disposal plants. In addition to the foregoing, there are other reasons which would make

the sealing of the sewers impracticable and inadvisable.

The exclusion of inflammable wastes from a sewer system brings up the question of how it shall be accomplished. The regulations of the Municipal Explosives Commission of the city of New York, adopted January 3, 1912, require the installation of oil separator traps or similar apparatus. The city of Boston requires a special trap which will prevent the discharge of the objectionable wastes into the sewers, and the city of Chicago has somewhat similar regulations to those of New York, governing this matter.

The efficiency of these devices is dependent upon the attention paid to their operation by the individual. Careless operation or neglect might render them of little value and defeat the purpose for which they were installed. Therefore, frequent inspection should be made by the proper public officers. Their general use on all sewer connections where gasoline or other inflammable waste is discharged would seem prohibitive, if found otherwise advisable, on account of the cost. The compulsory installation of devices for removing oil will generally meet with opposition by those affected, which has been recently demonstrated by the passage of an ordinance in New York City repealing the ordinance requiring the installation of oil separators. I am informed that this repealing ordinance was vetoed by the Mayor.

¶ LEGISLATION *on the subject must be most carefully formulated if it is to be effective.*

Formulation of legislation directed toward the prohibition of the discharge of inflammable wastes into sewers is at present receiving attention in many cities. That the same may be effectual requires the most careful consideration. It is most desirable that the necessity for such regulations be demonstrated and the efficiency of any device thoroly proven before they are required by ordinance.

The writer has examined the regulations of a number of cities and has come to the conclusion that it would be best from the standpoint of enforcement, to have all regulations of this nature contained in a single ordinance which would cover all phases of the discharge of wastes of all descriptions into the sewers. Such an ordinance should contain the following:

¶ GENERAL PROVISIONS *of ordinances designed to prevent sewer explosions are briefly stated.*

A. Prohibition against the discharge of any inflammable gas, volatile inflammable liquid, inflammable liquid, oil or gas, or any calcium carbide or residue therefrom, or any liquid or other material or substance containing inflammable gas or which would evolve an inflammable gas when in contact with water or sewage.

B. Regulations as to how sewer connections with establishments from which the foregoing wastes emanate may be made. This may, or may not, require the installation of special traps, separators or similar devices.

C. Provision for the examination and approval of all intercepting devices and provision for their inspection, maintenance and operation.

D. Provision with regard to the discharge or placing of obstructing material in any part of the sewer system.

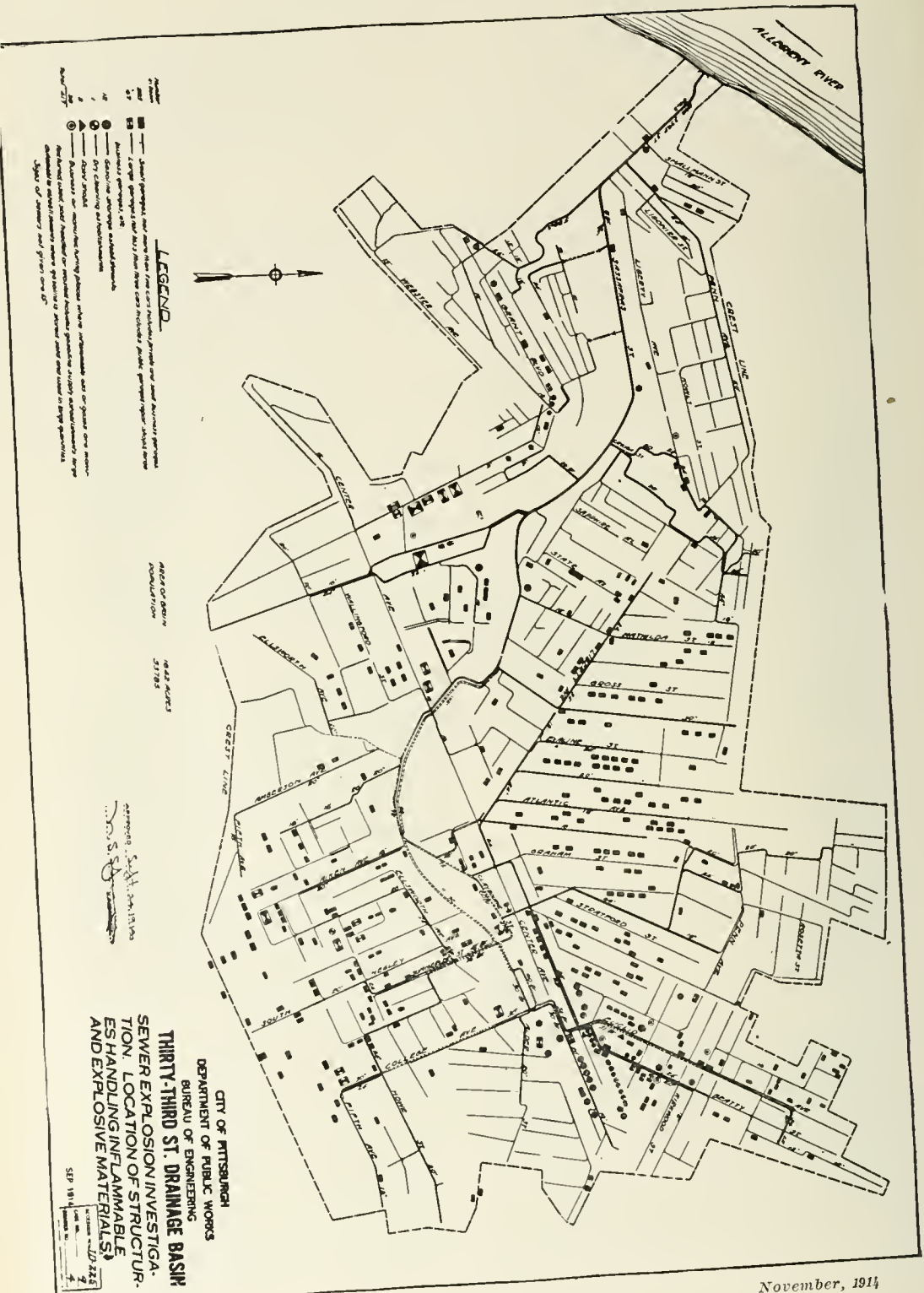
E. Regulations as to the discharge of steam or hot liquid or gaseous waste into the sewers.

F. Regulating the location of gas pipe in city streets with reference to the sewer; prohibiting the placing of gas pipes close to or within the masonry of sewers.

G. Prohibiting connections from manholes, gate boxes, or other apparatus of public service corporations to the sewers, except in an approved manner and when properly trapped.

Legislation alone will not secure or prevent the discharge of these objectionable wastes into sewer systems, but by informing the people of the damage resulting from this pracice, the offense will be greatly lessened.

It would appear desirable, in the interest of public safety, where oil separators or similar devices are installed, for the



November, 1914

municipality to undertake the final disposition of the residue rather than entrust it to the individual. The importance of the problem and the necessity for its strict and effectual regulation has been amply and forcefully demonstrated by recent violent and destructive explosions.

¶ SERIOUS EXPLOSIONS *in Pittsburg sewers have occurred in the past year, and others in other cities are only less serious and less expensive.*

As recently as September 22, another serious explosion occurred in Pittsburg in the sewer on East 42nd street, between Third avenue and the East river, making the third explosion in the same sewer within a year. Reports state that the physical damage to the sewer, buildings and street, was not extensive. This is accounted for by the fact that the sewer was a brick lined tunnel in rock about forty feet below the street surface. Under less favorable conditions of location and design this result would have been far more serious.

The most disastrous and expensive sewer explosion up to the present time, altho entailing no loss of life, occurred at Pittsburgh, Pa., November 25, 1913. This explosion to date has cost the city about $300,000, which may be increased by possible damage suits.

This problem is not confined to the prevention of explosions in the sewers themselves, but may extend to all kinds of sewerage works, as shown by the explosion in the screen chamber at East Boston, which occurred June 1st, of this year. In this explosion, which was caused by the presence of gasoline vapor, six lives were lost and three men severely injured.

Without mention of other recent sewer explosions, it is evident from experience covering many cities, that an immediate, effectual and permanent remedy must be found to control the situation. With three explosions in the 42nd street sewer in New York and two in the 33rd street sewer in Pittsburgh, all within less than a year of each other, there can be no question but what the conditions inside of all large sewers draining garages, etc., are such as to produce explosions whenever ignition occurs. The safety of the public and the welfare of the community are, therefore, now dependent more upon good fortune than the certainty of scientific control, hence the public is always exposed to the hidden danger which only requires a chance spark to cause havoc and disaster. The present situation can be likened to the man sitting on a key of powder.

¶ INVESTIGATIONS *with a view to future prevention are now in process by the city and the U. S. Bureau of Mines.*

The city of Pittsburgh, immediately after the second explosion, set about to make an investigation and study with a view of preventing a repetition of such disasters. This investigation is being conducted jointly by the city and the local office of the U. S. Bureau of Mines, who have rendered valuable assistance and advice.

The purpose of this investigation, which is still in progress, is:

First. To locate all possible sources from which gasoline or other explosive wastes might enter the sewers.

Second. To determine, by a series of examinations and tests, the location of the sources where the waste was discharged.

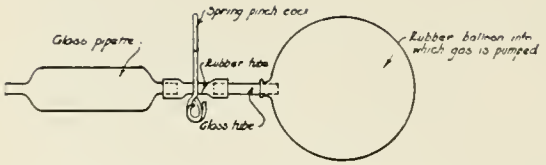
Third. The determination of the presence, extent and quantity of vapor within the sewers.

Fourth. Experiments to determine the effect and behavior of gasoline dumped into the sewer in different quantities and at different intervals.

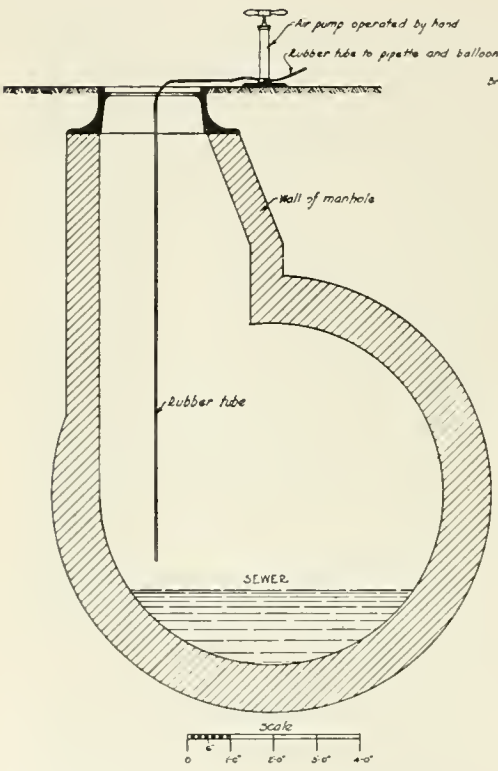
The 33rd street drainage basin was selected for study because of the number of garages within the basin and the fact that two explosions have already occurred, indicating the discharge of large quantities of explosive waste into the sewer.

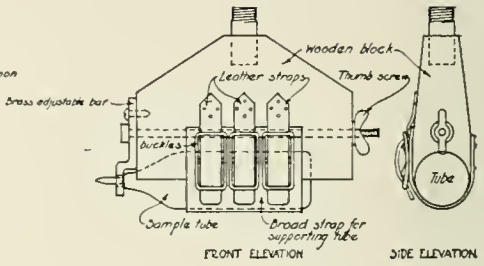
The 33rd street drainage basin has an area of 1,642 acres, a population of 53,785, and a total of 417 structures where inflammable and explosive materials are handled. These structures are classified as folows:

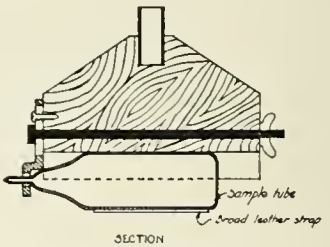
Two hundred ninety-five small garages,



SKETCH OF PIPETTE AND BALLOON
scale







SKETCH OF APPARATUS FOR COLLECTING GAS SAMPLES FOR ANALYSIS
scale

CITY OF PITTSBURGH
D P W
BUREAU OF ENGINEERING
SEWER EXPLOSION INVESTIGATION
APPARATUS FOR TAKING SAMPLES OF AIR INSIDE OF SEWER
SEPT 17 1914

not more than two cars, includes private and small business garages.

Sixty-seven large garages, not less than three cars, includes public garages, repair shops, large business garages, etc.

Twelve gasoline storage establishments.

One dry cleaning establishment.

Two paint shops.

Thirty-nine business or manufacturing places where inflammable oil or gases are manufactured, used, sold, handled or washed; includes gasoline supply establishments, large automobile establishments where gasoline is stored, sold and used in large quantities.

A map was prepared showing the outline of the basin, the sewer system within and the location of all garages, dry cleaning establishments and other places where inflammable or explosive wastes are likely to be discharged into the sewers. The map will be used in connection with studies to locate the point or points where the discharges of inflammable wastes occur.

Letters of inquiry were sent to all the principal cities in the country with a view of obtaining data and information relative to sewer explosions and what laws or ordinances were in force regulating or controlling the discharge of inflammable or explosive wastes into the sewerage systems. The answers received in reply to these inquiries were compiled and have been printed in pamphlet form and copies furnished to each city supplying information.

Apparatus was designed for securing samples of air within the sewer and for making field tests of same. The apparatus used in shown upon the accompanying plan.

The results so far secured in the investigation indicate the presence of gasoline vapor in the sewers of both the 33rd street and Negley Run systems. This latter system drains an area of about 2,500 acres with a population of about 50,000 and there are considerably less sources from which inflammable wastes are discharged than in the 33rd street system. Analysis of a series of samples taken on the same day at various points in these systems have shown that gasoline vapor in small amounts is present thruout the sewer system. The gasoline vapor ranges from 0.012 to 0.065 per cent. of the volume of sewer air in the sample. While these percentages of gasoline vapor are considerably below the danger mark, which may be taken as 2 per cent., it goes to show that the natural ventilation of these sewer systems is not sufficient to remove the effects of the ordinary or normal discharge of gasoline.

The Negley Run system drains thru duplicate outlet sewers for a distance of over a mile, during which distance there are no connections known which could by any possibility discharge gasoline. Above this point, there are a number of large branch sewers of considerable length so that taking these larger sewers of the system together with the many miles of laterals, with the opportunity for ventilation provided, it must follow that natural ventilation would not suffice to remove the effects of the discharge of gasoline in large doses.

It is expected that these experiments will require considerable time before definite conclusions can be reached and preventive measures, based upon same, can be formulated, but it is hoped that some plan or action can be devised which, without imposing hardship or undue expense upon the people, will secure to them freedom from the peril and danger to which they are now constantly exposed.

[The accompanying map shows the Thirty-third street drainage basin and the large number of small garages containing not more than two cars, and the relatively small problem in taking care of larger sources of materials liable to produce explosive mixtures in sewers.

The page of drawings shows the rubber tube let down to the level from which air sample is desired; air pump to draw the gas up; pipette and balloon to receive the gas; also glass tube for receiving samples and apparatus for handling it.]

Re-cut Granite Block Paving in Bronx Boro, New York City.

By George C. Thompson, Engineer of Highways.

Much interest has developed recently in the recutting of worn granite blocks taken from old pavements and relaying them by modern methods. The boro of the Bronx, New York City, was the first municipality to lay such pavements in considerable area, tho perhaps not the first to try the experiment. Mr. Thompson is therefore fitted by experience to describe the beginnings of the process and the improvements that have been made.

THE use of redressed granite blocks, so far as the writer knows, originated in the Boro of The Bronx, and the first piece of work was done under a contract dated September 18, 1909, and it was completed during the succeeding year.

The redressing of granite blocks was suggested to the then chief engineer of the boro by a contractor who was largely interestetd in laying pavement (especially granite blocks), and who also had extensive interests in granite quarries.

The events which led directly to the consideration of redressing old blocks were the letting of several contracts for repaving streets, where the old blocks were to be replaced with some other pavement, and the contractor was required in his bid to include a price per thousand for the taking up and removing of the old blocks from the street. The average price bid for the old blocks and their disposal was very low, it being considered that they were practically without value (the average price being $6 or $7 per thousand), and liable to be held by the contractor indefinitely.

The suggestion was made of trying to redress the blocks to a smaller size and relay with a cement grout filler, to insure the requisite stability. At this time (1909) the specifications for granite pavement on sand required blocks from 8 to 12 inches in length, 7 to 8 inches in depth, and from 3½ to 4½ inches in width, and the average cost for furnishing and laying was $2.86 per square yard, the number laid in a square yard being about 22 blocks.

The proposition to recut these blocks and relay them on a concrete foundation resulted in making specifications for doing the work, following rather closely the same requirement for joints as had been previously used for blocks on a sand foundation. When the letting occurred, the contractor who had made the suggestion proved to be the lowest bidder, at the following prices:

Taking up, redressing and relaying blocks, $1.27 per square yard.

Concrete foundation (1-3-6 mixture), $4 per cubic yard.

The work done under this contract covered an area of over 20,000 square yards of repaving, and included only the space from the railway tracks, existing in the avenue, to the curb on either side. Between the rails and between the tracks was relaid by the railway company with the original blocks on a sand foundation.

The proximity of the two pavements, laid by the different methods, furnished an excellent oportunity for comparison.

As a result of the satisfactory work obtained under the original contract, eight additional contracts have been let and completed for this class of pavement, with modifications from the original requirements, in the proportions of the cement grout filler, the size of the joints and some changes in the method of laying. In the original contract, the grout filler was 1 of cement to 3 of sand, but at the present time it is mixed with equal parts of sand and cement. The joints as at first laid were limited to one inch, and laid to about ¾ inch, while at the present time the maximum joint allowed is ½ inch. To October 1, 1914, there have been laid in the Boro of The Bronx over 212,000 square

yards of the redressed block pavement, which at contract prices has cost over $272,000, or about $1.30 per square yard average for taking up the old blocks, redressing the same and repaving with cement grout filler. The concrete foundation is not included in the cost given, but, as the concrete foundation would have to be provided, the cost of the pavement alone is comparable. The average cost of the redressed block pavement, with a 6-inch concrete foundation, has been about $1.90 per square yard.

At the present time the specification requirements for this kind of pavement are that the block must be from 6 to 12 inches in length, 4¾ to 5¼ inches in depth, and from 3½ to 4½ inches in thickness, and they must be so dressed as to give a smooth surface and lay with joints not exceeding ½ inch. These requirements are practically obtained. The contractor is obliged to maintain the pavement for a period of one year from acceptance as a guarantee of good workmanship. After this time the pavement is maintained by the city.

On contracts recently completed, the average number of blocks laid per square yard was about 38 for ordinary work, running somewhat less per square yard on railroad streets, where long blocks were laid at the rails.

The manner of conducting the work under the contracts is as follows: After the blocks are loosened, the clippers start in, and, with a tracer, score the blocks across the center and break them in two with a blow of a face hammer, leaving a smooth surface on each portion of the broken blocks. The edges are then dressed to the extent necessary to produce the required joint. As a rule, the clippers work independently, but occasionally two men work together, one man tracing the blocks and the other breaking and dressing them. Each clipper throws his blocks into a pile, from which they are culled, then counted and piled on the sidewalk.

The cost of clipping and redressing the blocks varies in accordance with the dressing required. Where the clipping consists of breaking the block in the middle and dressing the edges only, they have been let as low as $10 per thousand, and the tool sharpening done by the contractor.

Where the long blocks for laying against the rails of a street railway are dressed alone, $15 per thousand and sharpening is paid. Where old blocks are redressed to produce modern granite blocks, for first-class work, it costs $25 per thousand.

On a railroad street the blocks are taken up on one side of the roadway at a time, and traffic is maintained. As soon as the blocks are piled on the sidewalk (they are not removed from the street for redressing) the contractor proceeds to turn out the curb, dress to such extent as may be required, then reset same with a concrete foundation and backing, with enough concrete placed in front to form a bond with the roadway foundation, laid later.

The roadway is graded to allow a concrete base 6 inches in thickness, with the top of foundation parallel to the finished crown of the street, and at such a depth below the same as to allow a sand bed not less than 1½ inches in depth, in addition to the paving blocks.

Upon this sand cushion the redressed blocks are laid with close end joints, and joints between courses not exceeding ½ inch in width; longitudinal joints must be broken not less than 3 inches. As the blocks are laid, the joints are filled to within 4 inches of the top with gravel which will pass a ⅜-inch mesh, and be retained by a ⅛-inch mesh.

The blocks are then rammed to an unyielding bed, with a surface conforming to the grade and crown of the street. After the ramming has been done, cement grout, composed of one part of sand and one part of cement, is flushed into the joints. A second ramming is given before the grout sets, and the joints are again filled to the top with a somewhat thicker grout well broomed into the joints, filling them fully to the top of the pavement.

Traffic is kept off the grouted blocks until the grout has had sufficient time to set thoroly, running from 7 to 10 days, according to the conditions of the weather.

In most of the work done a grout surface has been spread over the top of the

blocks and then broomed to a smooth, uniform surface. Unless this is properly done, the surface is liable to wear unevenly and the grout will chip off, leaving the top of the blocks entirely bare, while adjacent blocks will be perfectly covered. This action of the mortar surface has caused considerable annoyance and the cause has not been satisfactorily determined. In some instances it appears to be due to an insufficient ramming, in others to allowing the gravel in the joints to come too near the top of the block before the joint is grouted.

The quality of the granite block appears to affect the adherence of the grout, some of the very hard crystalline blocks not furnishing as good bond as those of finer grain and medium hardness. The writer would be very glad for any information that would explain this action and provide a remedy.

In the work done by Mr. Charles A. Mullen, Commissioner of Public Works in Schenectady, in 1913, many of the old blocks were found to be of sufficient size so that they could be split longitudinally and transversely, thus making four blocks of each one, and making an increase of about 100 per cent in the area that could be laid after redressing. For instance, a block which was 12 by 4 by 8 inches would lay 48 square inches. This would be cut to make four blocks 6 by 4 inches square, or would lay 96 square inches in the smaller block. This block, while shallower than the Bronx block, is reported to have made very good work at a low cost. An article by Mr. Mullen, in MUNICIPAL ENGINEERING for May, 1914, enters into the cost of the work done in Schenectady in great detail, as well as fully describing the methods of doing the work. He assures me that the cost data given in this article are based upon carefully kept returns, and are accurate for the work done. For the convenience of any one who may wish to inspect the Bronx work, I append information as to location, area and contract prices.

Title.	Total Yardage.	Granite Blocks Recut and Relaid, per sq. yd.	Pavement per sq. yd., Including Concrete Foundation.
Webster avenue, from 165th to 171st street	20,227*	$1.27	$1.94
Park avenue E., from 156th to 161st street	5,241	1.31	1.81
East 151st street, East 155th street, East 155th street, East 160th street, East 161st street, Melrose avenue	32,256	1.38	1.55
179th street, from Park avenue to Third avenue	1,815	1.75	2.69
Southern boulevard, from Willis avenue to 138th st.	26,672*	1.05	1.75
Third avenue, from 150th street to 177th street	71,369*	1.92½	1.86½
Webster avenue, from 178th street to 177th street.	24,902*	1.22	1.90
Tremont avenue, from Webster ave. to Third ave.	6,371*	1.45	2.18
Tremont avenue, from Third ave. to Boston road.	23,698*	1.53	2.36

*Railroad streets.

In the above mentioned contracts, any excess of blocks belonged to the contractor and any shortage had to be supplied by him at his own expense.

Economics of Sewage Filters.

By George W. Fuller, Consulting Engineer, New York City.

The author of this paper is well fitted by experience to discuss and compare methods of sewage treatment with reference to their relative economic value, and gives much food for thought and careful examination by those trying to find the best method of sewage purification for their particular conditions.

SEWAGE filters may be divided broadly into three classes:

1. Intermittent sand filters or their equivalent. This consists of a body of sand or fairly pervious material of other kinds. The sewage is distributed over the surface of this porous material, and at the bottom the filtered sewage is collected in underdrains. In order to get the benefit of oxidation in the pores of the sand bed, the application of the sewage to the filter is intermittent, with periods of rest and aeration.

2. The second type is the so-called "contact" filter. This consists of a body of practically any thickness of stone or equivalent material, such as large-sized gravel, pieces of porcelain, brickbats, cinders, or almost any coarse-sized granular material. The sewage is applied to such a filter either from the bottom or from the top, so as to fill the bed. The sewage is allowed to stand in this filter bed for a given time. It is then discharged and the empty bed is allowed to stand for a period.

3. The third type is the so-called "sprinkling" filter. This consists of a body of stone of a minimum depth of five feet, on which the sewage is sprinkled or sprayed and spread by nozzles and distributed in small quantities so that the sewage trickles down over the stones and is collected at the bottom.

All three types of filters effect the purification of the sewage in the same way. Thru the action of the bacteria present in the filter bed the sewage is to some extent oxidized and the organic matter is broken up. Unstable forms of matter are changed into more stable forms. While the exact form of action is unknown, it is believed that the three types of filters act in the same way, and the difference is rather a mechanical one of form of application than one of principle of action.

Performance of Filters—The output of a filter of any type, measured in any suitable purification unit, is largely a question of local conditions. It depends upon the nature of the sewage, the nature and fineness or coarseness of the filtering material, the method of application of the sewage to the filtering material, temperature, atmospheric conditions and many other factors. The intermittent sand filter is, best used when it is desired to have a very high degree of purification. The other types, the contact filters and sprinkling filters, are used for a rather lesser degree of purification. It is to be understood that the rate of application of the sewage to the various types of filters must be properly proportioned to the ability of these filters to take care of the sewage. By using a suitable rate under suitable conditions, any type of filter can be made to give any degree of organic purification that may be desired.

Rate of Application of Settled Sewage to Filters—The question of the rate of application of sewage to a sand filter is largely tied up with the question of preliminary treatment in the way of tankage or screens. Quoting from my book, "Sewage Disposal," we make the following table for several cities in Massachusetts of the population whose sewage can be treated per acre of filter bed, with the time of detention in preliminary sedimentation tanks, storage wells, pump wells, or other means of storage. These figures are not to be taken to represent present conditions.

	Period of Detention, Hours.	Population.
Andover	1½-3	950
Brockton	12	1,160

Clinton	12	425
Framingham	12	375
Gardner (Old)	1½	1,310
Gardner (New)	1½	2,000
Pittsfield	12	605
Stockbridge	8	220
Worcester	1½	1,390
Average of all	6.7	937

The Baltimore Sewerage Commission in 1906 estimated that, using a sand filter with 3 feet of clean sand over the gravel, an allowance of 150,000 gallons of 6-hour settled sewage per acre in 24 hours, corresponding approximately to 1,200 people per acre, would be a proper rate.

Data for contact filters are relatively scant in American practice, and, while many English data are available, the differences, owing to the difference in the strength of the sewage, make such data rather dangerous as a basis of comparison.

A series of experiments in Columbus, Ohio, indicated that 5-foot-deep stone filters on the contact principle could be safely operated at an average of 600,000 to 700,000 gallons per acre per day. Reducing this to a 4-foot depth will give about 500,000 gallons per acre per day, which, on the basis of 100,000 gallons per capita per day, would give a loading of approximately 5,000 people per acre of stone bed.

A series of tests made at Lawrence on contact beds of various depths from 24 inches up to 18 feet showed an average output of some 700,000 gallons per acre per day for a depth of stone on an average about 5½ feet. This is equivalent to an output of about 135,000 gallons per acre for each foot of depth of stone, or, for a 4-foot depth of bed again, is equal to about 500,000 gallons per acre per day, or, say, a loading of about 5,000 people to the acre.

The contact filter installation at Plainfield, N. J., with 3.6 acres of stone bed 4½ feet deep, gave in 1910 an output on an average of 1.7 million gallons of sewage per day. On the basis of an allowance of 100 gallons per capita per day, this will correspond with a 4-foot bed, to about 4,200 people per acre of filter.

For sprinkling filters much more satisfactory data can be had. Sprinkling filters have been used very extensively in this country of recent years and their ratings can be fixed with a good deal more dependence. A list of a number of plants or projected plants, giving the depths of the stone bed of a sprinkling filter and the loading in population per acre follows:

	Depth, Feet.	Population Per Acre.
Atlanta	6	20,000
Reading	5	18,000
Columbus	5	18,000
Baltimore	9	20,000
Montclair	7½	15,000
Philadelphia	6	20,000
Fitchburg	10	20,000
Mount Vernon	8	24,000

The average of all these shows a 7-foot deep bed and average loading of 19,400 population to the acre.

Not considering special conditions, and just taking fair figures, we may safely state the following:

Intermittent sand filters, 3-foot bed of sand, loading 1,000 population per acre.

Contact filters, 4-foot depth of stone, loading 5,000 population per acre.

Sprinkling filters, 7-foot depth of stone, loading population 19,000 population per acre.

The rates, then, for these three types of filters are in the ratio 1, 5 and 19 feet.

Cost of Sewage Filters—Costs of construction are so much affected by local conditions, such as the amount of excavation necessary, the cost of various classes of materials, the distance from which various classes of material must be obtained, details of local construction conditions, such as competition, class of work required, and others, that comparative costs for different localities are only to be used with great discretion, and individual cost and even averages are only a guide to comparative costs in various places. Having this limitation in mind, we will examine in a rough way the cost of various types of sewage filters on the per capita basis.

The average cost of the nine Massachusetts intermittent sand filters cited above is $3,260 per acre, as reported in the Massachusetts State Board of Health report of 1903. This gives a cost per capita connected to the filters of $3.50.

The 1906 Baltimore Sewerage Commission estimates the cost per acre of filters at $6,350, these filters being suitable

for a connected population of 1,200 per acre. This corresponds to a per capita cost of $5.30.

The cost of contact filters, varying, of course, with the degree of the fineness of the design, may be taken, for filters equipped with suitable convenient appurtenances, at $30,000.00 per acre for a 4-foot deep bed. This corresponds with a loading of 5,000 population per acre to a per capita cost of $6.

For sprinkling filters 7 feet deep the cost will be about $45,000 per acre. On the basis of a loading of 19,000 population per acre, the cost per capita will be $2.37.

When considering the relatively low cost of the Massachusetts sand filters compared with the estimate made from the Baltimore sand filters, it is to be borne in mind that the conditions in Massachusetts for the construction of sand filters were unusually favorable, and do not represent average conditions thru the country. In most places the costs would approximate more nearly those estimated for Baltimore.

Taken in a broad way, sprinkling filters are a far more economical installation in the matter of first cost. Intermittent sand filters and contact filters do not stand far apart in this particular.

Relative Cost of Different Depths— There is not very much known about the relative advantages of filters of shallow or deep construction. The choice of depth is usually made for entirely different reasons from those of obtaining the most economical construction to obtain the desired amount of purification. Very few tests of a comparative kind have been made to give convincing information, and the interpretation of the tests has not been uniform. In some places the conclusion has been made to make filters say 10 feet, at other places 6 feet, and some study is worth while to determine what, if any, difference there be in the cost of such construction at different depths, and which appear to be the better. It is to be assumed in such comparisons that sufficient head would be available in any case for the greatest depth to be considered and that pumping would not be necessitated by building filters of the greater depth.

For intermittent sand filters questions of depth do not arise. The filters are generally made as shallow as is consistent with getting proper results, and sand beds are not usually made more than 4 or 5 feet deep as a maximum. Shallower beds, even, will give about the same output as the deeper beds, and beds are made deep only so that sand may be removed for cleaning without removing the sand for a considerable period.

With contact filters it is recognized that from the nature of the action of the contact filters, where the amount of air that is drawn in between fillings of sewage is practically equal to the volume of the sewage, and where surface clogging cannot be a serious factor and may even be no factor at all, each unit of volume of the stone forming the filter, say each cubic yard, will give the same output of sewage purification, no matter what may be the depth of the filter.

From this it follows that it is economical to build a sewage filter on the contact principle as deep as local conditions of construction will permit, and the limitation of depth which it is economical to use is therefore made by the factors of earth excavation or fill and the possible head available without pumping.

When it comes to sprinkling filters, the problem becomes a little more complicated. The English experience, as recited in the report to the royal commission, seems to indicate that the output per unit of volume of sprinkling filters is the same, no matter what the depth. Our experience in work in this country does not wholly corroborate this information. Our best knowledge seems to indicate that the output per unit of volume of sprinkling filters is somewhat less for deep filters than for shallow filters. For such conditions, with a relatively decreasing efficiency of the stone of the filter beds for greater depths and at the same time a relatively decreasing cost per unit volume of the stone for deep beds, there must come some point where the greatest output per unit of cost will be obtained.

The report of the Baltimore Sewerage Commission in 1911 gives some informa-

tion obtained from tests made in Baltimore as to the relative efficiency of various depths of broken stone of sizes 1 to 2-inch stone, which is the one most commonly used. Figures obtained from that source show that the following:

	6 ft.	9 ft.	12 ft.
Relative stability	79	87	89
Per cent. reduction of oxygen consumed	56	70	72

Giving equal weight to the relative stability and per cent. reduction of oxygen consumed, we get the following:

	6 ft.	9 ft.	12 ft.
Relative stability	1	1.2	1.23
Per cent. reduction of oxygen consumed	1	1.25	1.28
Average of the two	1	1.22	1.25
Relative depths	1	1.33	2.00
Relative value of stone per cubic yard	1	.92	.63

Assuming this depth varies at a uniform rate from one end of the curve to the other, we get the following for the relative value of stone per cubic yard:

Relative Depth of bed, feet	6	7	8	9	10	12
Relative value of stone per cubic yard	1.0	0.97	0.94	0.92	0.82	0.63

To get comparative figures then between the 6, 8 and 10-foot beds the cost figures for the 8-foot beds must be divided by 0.94, and the cost for the 10-foot beds by 0.82, putting them all on the basis of the 6-foot beds.

For comparative cost a number of factors, such as excavation, etc., are naturally omitted, as they are not affected in all places the same way by the depth of the filter. Comparing, then, only those particular costs which are affected per unit of output by the depth of the filter, we get the following:

	Per effective cu. yd. Depths.		
	6 ft.	7 ft.	8 ft.
Floor—Take at 0.40 per cubic yard for a 6-foot bed. Floor	$0.40	$0.35	$0.32
Tile—Take 11c per square foot for any depth	.49	.44	.40
Walls—Assume cost 0.17 per cubic yard for 6-foot depth	.17	.17	.17
Galleries and Collectors—Assume for 6-foot depth 0.25 per cubic yard	.25	.22	.20
Distribution—Assume 0.50 per cubic yard for 6-foot depth also, as costs theoretically vary only according to quantity delivered, they must be same for all effective depths per cubic yard	.50	.50	.50
Stone—Assume $1.50 per cubic yard	1.50	1.55	1.60
Total	$3.31	$3.23	$3.20

Outside factors will depend on quantity only and not on depth.

It appears, then, that there is some slight saving of cost, which, on the figures given in the table, amount to about 3 per cent. in favor of the 8-foot bed as compared with the 6-foot bed. On the other hand, it is to be recognized that a deep bed will give a good deal more trouble with pooling and freezing than a shallow bed, and the advantages in favor of a shallow bed due to this lesser amount of pooling will be considerably more than this 3 per cent. difference in cost. Taking everything into account, the writer believes that a sprinkling filter bed of not less than 6 feet and not more than 7 feet will in the greater number of cases prove the most economical to use.

Gas Leaks Under Bituminous Pavements.

By George C. Warren, Boston, Mass.

There has been some difference of opinion as to the effect of illuminating gas upon bituminous pavements, due to lack of information on the subject and to the differences in effect upon various asphalts. These experiments by Mr. Warren show the facts in one series of cases, and the accompanying discussion by S. R. Church extends the application to other cases, and they demonstrate the serious nature of the effects of leaking illuminating gas upon the bituminous pavement which it may pass thru.

TO everyone who has had long experience in bituminous pavement construction and maintenance, it is well known that illuminating gas escaping from subsurface gas mains is very injurious to all forms of bituminous pavements, and yet we frequently find representatives of gas companies and city officials ridiculing the idea that gas can have any effect on such pavement surfaces.

The fact is that illuminating gas, a bituminous substance, and hydro-carbon, quite similar in its chemical composition to light tar and oil distillates, is lighter and more penetrating than the distillates and even more rapidly attacks and liquefies a bituminous cement, no matter whether the bitumen be a tar or an asphaltic product.

EXPERIMENT NO. 1.

For testing the effect of illuminating gas on asphalt there is submitted herewith a very simple apparatus and photograph thereof.

Photo taken at start of experiment, August 18, 1914.

Illuminating gas entered at tube "C," filled the jar and passed out at tube "D" to a burner.

Gas passed thru jar daily 8 a. m. to 5 p. m., from August 18, 1914, to October 5, 1914, except Sundays and Labor Day, but naturally the jar was filled with quiet gas during nights, Sundays and Labor Day.

The glass jar contains two baskets of No. 10 mesh screen.

Basket A contains 1-inch cube of hard California refined asphalt penetration 20 degrees Dow.

Basket B contains 1-inch cube of mixture consisting of 90 per cent. well graded sand and 10 per cent California asphaltic cement (75 degrees Dow.).

A similar jar and contents, which was not subjected to gas, has been kept alongside of the "gas jar" during the experiment to show that softening of material in the gas jar was due to gas and not change of temperature, and is exhibited herewith. (See Photo 6.).

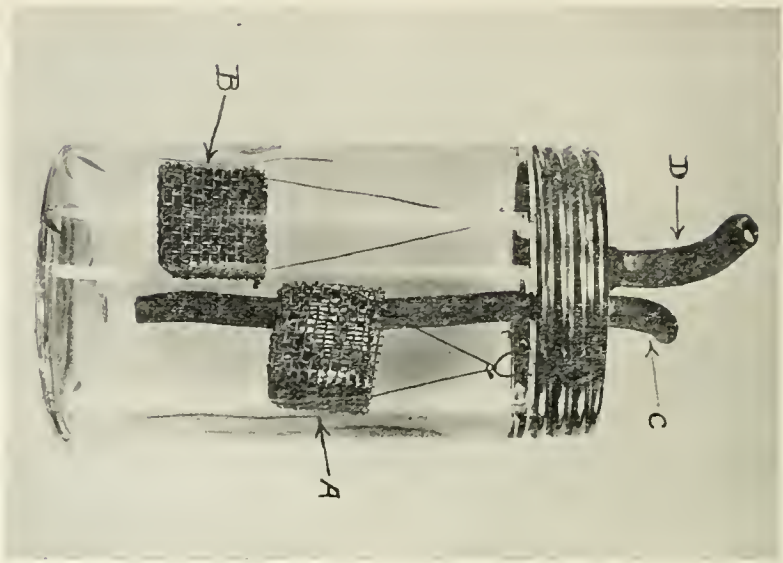
Photos 2 to 5 inclusive are of the same jar as shown in Photo 1, taken during the test of six weeks on the following dates, respectively: September 3, 12, 16 and 24.

Photo 6 shows that the softening was in no way due to change of temperature.

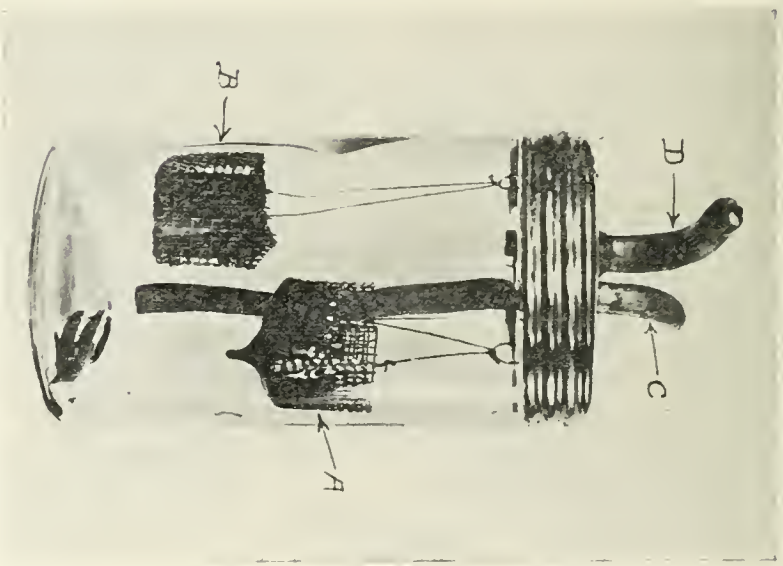
The daily diary of condition of asphalt and mixture is as follows:

EXPERIMENT STARTED AUGUST 18, 1914.

	Asphalt Basket.	Mixture Basket.
Aug. 19 to 27	No noticeable change.	No change except mixture glossy and sticky.
Aug. 28	Asphalt began to creep thru, looking like small heads in the wire mesh.	Ditto above.
Aug. 29	Ditto above.	Ditto above.
Aug. 30	Gas turned off; Sunday; no observation.	Ditto above.



GLASS JAR CONTAINING BASKETS *of hard asphalt and sand asphalt mixture. Photo 1.*



GLASS JAR SEPT. 3, 1914, *after fifteen days' exposure to gas. Photo 2.*

Aug. 31—Outside of wire basket coated with asphalt which had crept thru the mesh.	Ditto above.
Sept. 1—Above condition slightly increased.	Ditto above.
Sept. 2—Asphalt forming drop at bottom of basket.	Ditto above.
Sept. 3—Asphalt increasing in softness; above drop has formed long pendant and small portion dropped to bottom of jar. See Photo 4.	Ditto above.
Sept. 4—Ditto above; more drops.	Ditto above.
Sept. 5—Ditto above; more drops.	
Sept. 6—Sunday; gas turned off; no observation.	Sunday.
Sept. 7—Holiday; gas turned off; no observation.	Holiday.
Sept. 8—Three distinct pendant drops of asphalt surface settled half way down basket.	Same as Sept. 5.
Sept. 9—Same as above.	Same as Sept. 5.
Sept. 10—Same as above.	Same as Sept. 5.
Sept. 11 to 28—Impossible to make intelligible diary, there being almost imperceptible changes from day to day. There has been, however, continuous but slow leakage of asphalt from the basket. The long pendant drop shown in Photo 2 broke on September 12. A new drop started to form at that time and on September 28 had reached about three-quarters the distance from basket to bottom of jar.	

RESULTS OF EXPERIMENT NO. 1.

	Mixture Basket	Refined Asp. Basket
Net weight of material at start	17.90 grams	14.13 grams
Net weight of material Sept. 28 (41 days)	18.04 grams	10.52 grams
Increase in weight	.14 grams	.....
Equals 0.78 per cent. of the mixture, or 8 per cent. of the bitumen.		
Amount of asphalt dripped from basket		3.61 grams
Amount of asphalt dripped from basket		23.50 per ct.

The paving mixture of asphalt and sand has become reduced to the condition of a mixture of heavy oil and sand.

The foregoing experiment clearly proves the following fundamental facts:

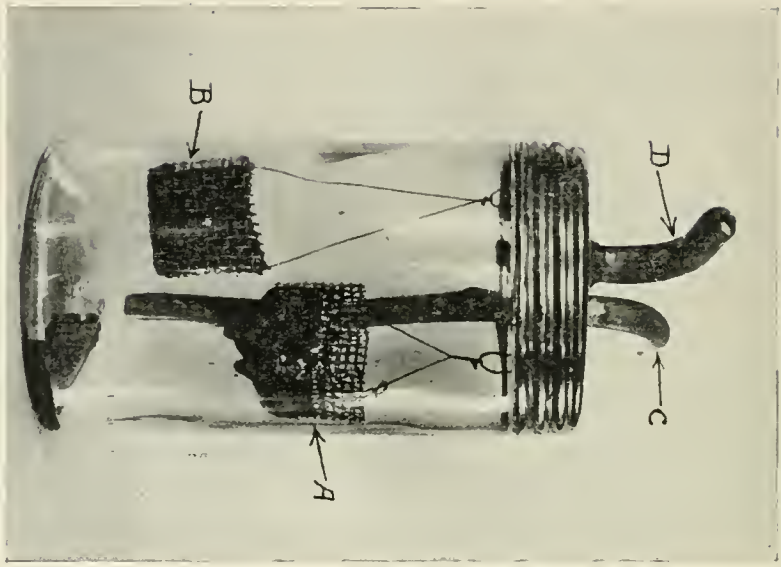
(a) That illuminating gas without agitation rapidly liquefies asphalt cement and refined asphalt and destroys its value as a cementing medium.

(b) That illuminating gas not only attacks, but combines with the asphalt, increasing its weight.

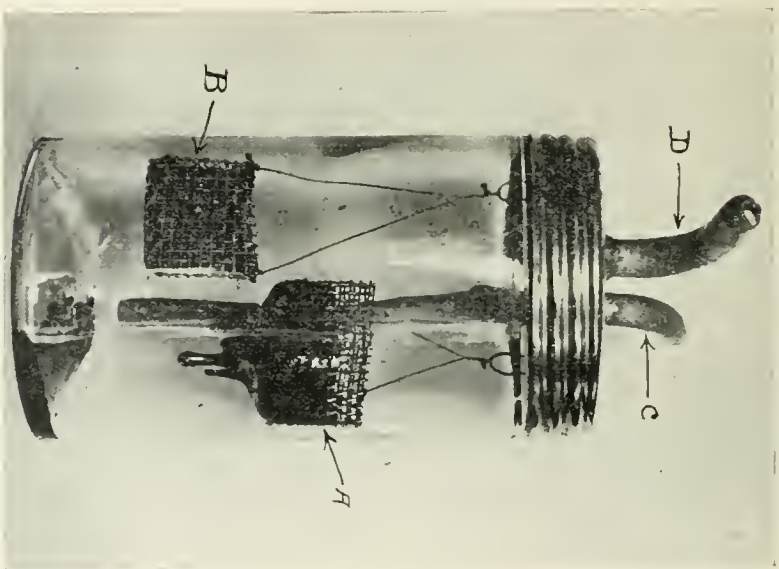
EXPERIMENT NO. 2.

Commercial illuminating gas is very complex in composition, and the portion which produces the luminous portion of the normal flame is very similar in composition to benzol, which, when chemically pure, is practically a perfect solvent for the bitumen which is the active component of all asphalts and coal tar pitches.

It is but natural, then, that when this gas comes in contact with any bituminous cement, more or less of the "illuminants"



GAS JAR SEPT. 12, 1914, *after twenty-four days' exposure to gas. Photo 3.*



GAS JAR SEPT. 16, 1914, *after twenty-eight days' exposure to gas. Photo 4.*

of the gas are absorbed by the bituminous cement, and the candle power of the gas is correspondingly reduced, and it is on account of this fact that the gas companies not only exercise the greatest possible care in cooling the gas to condense and separate out as completely as possible all oils and tars, but also for many years have insisted that all the cast iron pipes used as mains be coated with "asphalt dip" on the outside only, even tho such pipe is more expensive.

In the ordinary process for the manufacture of coal gas the candle power is usually less than desired and the gas is usually enriched by the addition of water gas, the latter being produced by the chemical combination of petroleum oil and steam under application of high heat.

It may not be generally known to those present, however, that in the absence of a carbureted water gas plant the most available method of enriching the gas is the direct addition of benzol vapor to not over 3 per cent.

In order to show the rapidity with which asphalt cement will absorb illuminants from gas, Experiment 2 is submitted herewith:

The apparatus is designed to show the comparative brilliancy of two flames of identical size, one burning normal gas which has passed thru a glass tube containing dry sand, the other flame burning gas which has passed thru a corresponding ¾-inch tube, 32 inches long, containing a sand-asphalt mixture. It will be noted that in the case of the normal flame the "blue" portion is very small and the flame luminous, while in the other the "blue" portion of the flame is relatively much larger and the flame itself much lower candle power.

While this comparison can be plainly seen, as shown in Photo 7, the contrast is more marked when the oiled paper screen is placed in front of the burners, as shown in Photo 8.

From the point of view opposite to Experiment 1, Experiment 2 proves the injurious effect on illuminating gas by contact with asphalt or other viscous bituminous material.

EXPERIMENT 3.

Having proved the effect on the bituminous cement and on the illuminating gas by their contact with each other, the next step in our experiments is to measure that effect on the bituminous material as a softening agent.

This experiment was made by filling a one-quart fruit jar about 6 inches deep with liquid asphalt of specific gravity of 1.0 on afternoon of September 18. It is necessary in carrying out this test to employ liquid asphalt, and also to apply the gas under higher pressure than is on the ordinary gas burner, in order that the gas may pass freely thru the asphalt.

Two tubes were inserted, one for inlet of gas extending to bottom of jar, the outlet tube being, of course, above the surface of the asphalt, with a burner at top of tube. With the exception of Sundays, September 20 and 27, gas has been passing thru this asphalt and burned at outlet.

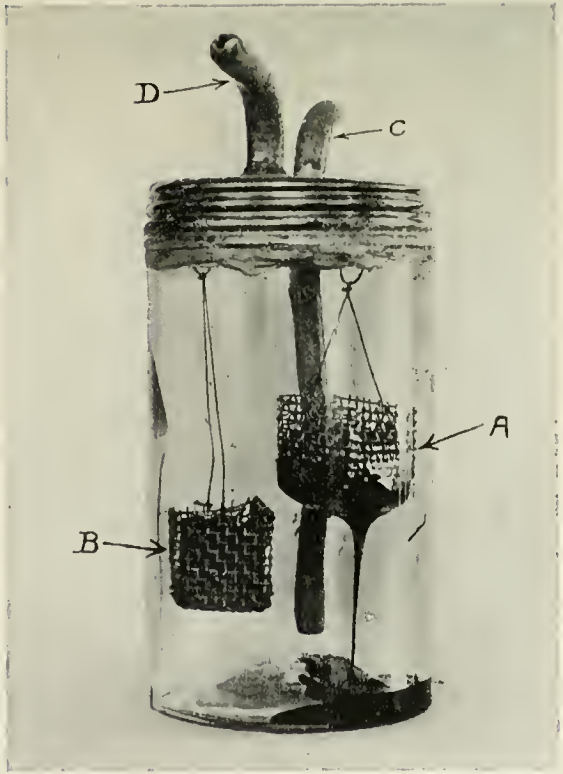
After twelve days' exposure to gas the asphalt had increased 2.98 per cent. by weight and 4 per cent. in volume.

The comparative characteristics of this liquid asphalt before and after the above exposure to gas are as follows:

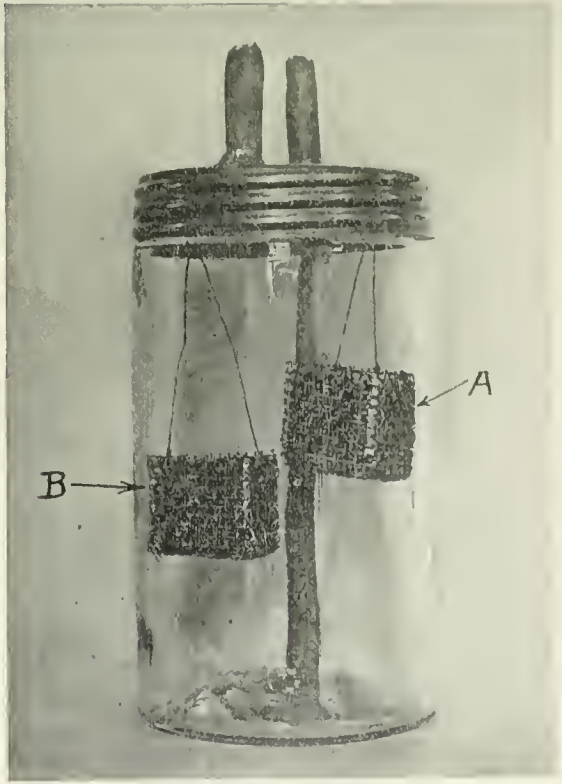
	Before.	After.
Specific gravity at 60 deg. F..	1.00	0.99
Flash point, deg. F.....	190	120
Engler viscosity—		
1st 50 c. c., sec.....	153	75
2nd 50 c. c., sec.....	170	90
Weight, grams 953.1		983.6
Increase of weight, per cent..		2.96
Volume, c. c. 955.1		993.5
Increase in volume, per cent..		4

It may be well to here state that while asphalt and sand mixtures are used in making these tests, being more convenient for small experiments than coarser bituminous mixtures, it is not intended to claim that one bituminous paving mixture is more readily affected by gas exposure than another, and more particularly it is not claimed that the particular form of bituminous pavement surface in which the writer is most commercially interested is affected to any less degree than other bituminous mixtures.

The foregoing is of practical as well as scientific interest and believed to be worthy of record in the proceedings of



GAS JAR SEPT 24, 1914, *after thirty-six days' exposure to gas. Photo* 5.



JAR CONTAINING *baskets of hard asphalt and sand asphalt mixture same as in the jar shown in preceding photos. This jar was not subjected to gas, but stood alongside of the other jar during entire experiment. Photo taken October* 5, 1914. *Photo* 6.

this society. To us, as practical road engineers and road builders, however, the important questions are the title of this paper, "The Effect of Leaking Illuminating Gas on Bituminous Pavements," and "What are we going to do about it?"

In my thirty years of experience with asphalt and other bituminous pavement construction, this matter has come up many times, and generally the persistent claim of the gas companies is:

1. That it is ridiculous to suppose that gas will attack an asphalt pavement.
2. That the gas mains have been carefully tested by plugging holes thru the pavement and into the ground and that there are no leaks.
3. When the main is on the side of the street opposite a portion of the street affected, it is too far away.

I would comment on these points as follows:

1. There can be no question but that coal gas, being a hydro-carbon in gaseous, and therefore its most penetrating, form, will attack any form of bitumen even more rapidly than oil, just as gasoline, being more penetrating, will attack bitumen more rapidly than heavier oil, such as machine oil, for instance.

I particularly remember one extremely aggravated case on West End avenue, New York City, about fifteen years ago, which became reaffected, and the asphalt pavement again ruined within three months after it was resurfaced, the gas company having claimed that they had thoroly tested the mains and repaired the leaks. Shortly subsequent to this the gas company was obliged to entirely relay the gas main and the pavement was again relaid.

2. Even if they dislike to, or will not admit it, the gas companies well know that the "plugging" test only *sometimes* locates the leaks. They naturally dislike to go to the expense of tearing up and relaying pavements and excavating to and uncovering the mains, unless the conditions become such that they are absolutely required to do so.

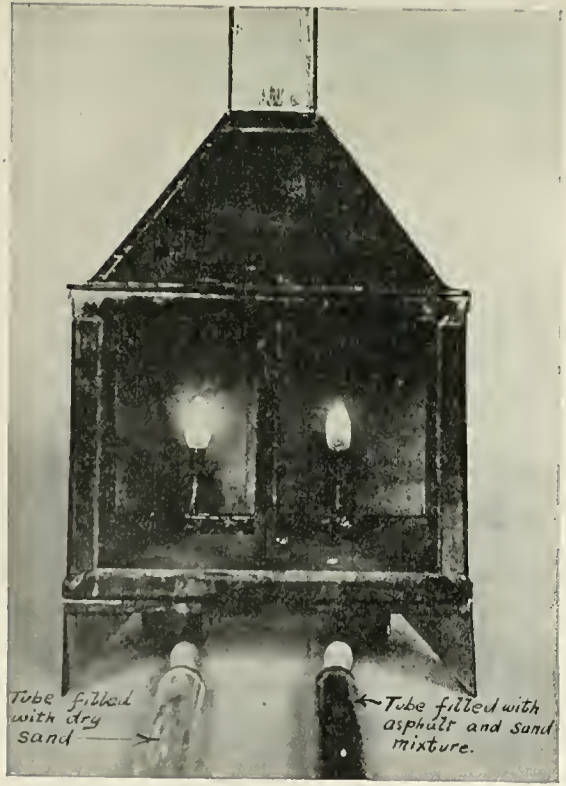
3. The leaking gas naturally follows the lines of least resistance, which may be in either a nearly vertical line and show the result almost immediately above the leak, or what is extremely hard to find, may follow a long distance thru a vein of porous earth or along the space formed by some old settled trench and reach the pavement surface a long distance from the leak. In such cases the pavement is generally affected over a large area, because the earth has become quite generally saturated with the gas, which gradually works up to the pavement surface.

I remember a case in about 1888 on Rutger street, Utica, N. Y., where the first indication of trouble in the gas main was the effect on the asphalt pavement. The gas company claimed they had repaired the leak and a considerable area of pavement was relaid. About a month later an elderly couple, while asleep in one of the residences nearly a block away, were nearly asphyxiated by gas leaking from the street. Probably the gas had first found a partial outlet, following along a vacancy in some trench settlement, and then thru the pavement. Subsequently the leak became worse, with the serious result referred to above.

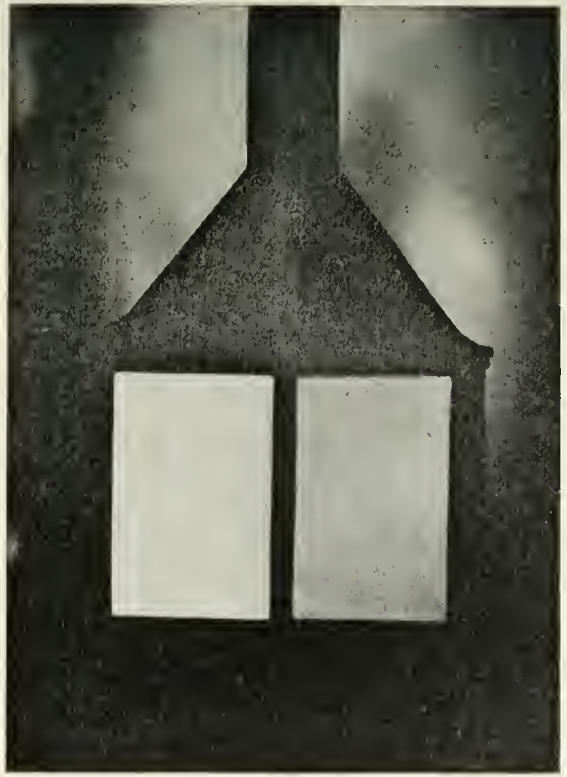
Frequently, if not generally, the first indication of leak in the gas main where the street is a bituminous pavement, is the effect on the pavement, in which case it is good fortune that the pavement is of a character which is affected by gas and will permit the gas to permeate the surface, thus lessening the chance of serious casualty as above outlined in Utica.

The visible effect of leaking gas on a bituminous pavement is a serious "shifting" or "rolling" of the pavement in its softened condition, accompanied by a breaking up of the surface into a "crackled" appearance not unlike the folds or cracks in an alligator's back.

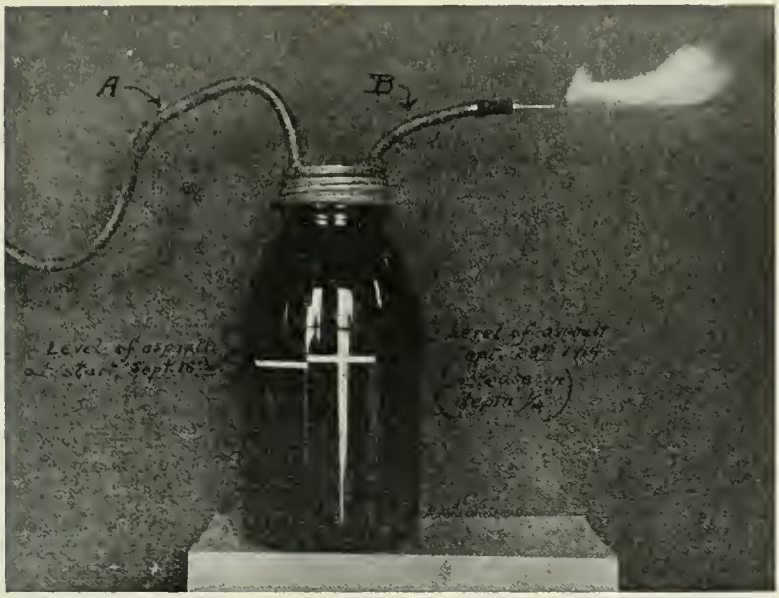
Generally when this condition is noticed, a perceptible odor of gas will be found in the pavement surface, but sometimes the leak may have been repaired or the gas taken another course and the gas escaped so that its odor cannot be detected, yet the pavement is left in a seriously damaged condition. On the other hand, under certain sub-soil conditions, the earth below the pavement may retain the escaped gas and continue to have its damaging effect for months, if not years, after the gas main has been repaired, and the cause of the trouble probably removed.



FRONT SIDE *of apparatus entirely open, showing the burners and character of flames. On left showing brilliant flame of normal illuminating gas. On right showing darkened flame from gas which has passed thru sand-asphalt mixture. Note the difference in the size of the "blue" portions of each flame and difference in brilliancy of the "halo" around each. Photo 7.*



FRONT SIDE *of apparatus closed by a translucent oiled paper screen, showing at left side bright light from normal flame and at right darkened light from gas which has passed thru sand-asphalt mixture. Photo 8.*



GLASS JAR *containing liquid California asphalt. Gas entering at A and out at B. Photo* 9.

The effect on the pavement may extend for a considerable period beyond the repairs to the gas main, unless steps are taken to provide frequent vents left open for several days if not weeks after repairs to the gas mains are made.

In such cases, before making repairs to the pavement, its entire surface over the main and where the surface shows the effect of gas, should be removed and the gas main should be thoroly repaired (renewed if necessary). After the leaks are repaired, vents or openings at least 1 foot square, extending from the surface to the level of the gas main, should be left open for two or three weeks longer, if there is still any odor of gas, and the openings then refilled and thoroly tamped and the pavement surface relaid. With this precaution the trouble will probably be overcome if the gas company has not been too parsimonious, inefficient or incomplete in making of repairs to the gas mains.

In conclusion, it may be well to call attention to a pernicious but quite general custom of the gas companies in their "hunt" for leaks. I refer to the custom of having two or three men, one of them selected for his "smelling" efficiency, go along the street, where there are Indications of gas leaks, hammering a cone-shaped bar thru the pavement into the ground below. These holes are made at intervals of a few feet. The "smeller" man puts his nose to the holes and if he discovers a sufficient odor of gas to attract his attention, an opening is dug to try to discover the leak. If the "smell" test does not locate a leak apparently below the hole, it is quietly filled with dirt. A few weeks later the city official, or the "poor devil" of a paving contractor, if he happens to have the pavement under "guaranty," finds serious holes along the center line of the pavement and not being able to trace the trouble to any cause, he makes the repair, if his "guaranty" is good, or "lets it slide" if he and his "guaranty" are no good, and perhaps at the end of a law suit the city makes the repairs. The simple, but so far as the writer knows never enacted, cure for this evil is an ordinance requiring gas companies, whenever they want to test their mains, to cut openings of sufficient size thru the pavement to enable excavation to the gas main, abso-

lutely prohibiting the promiscuous drilling of holes thru the pavement as above described and to pay for making a proper repair to the pavement. With the enactment and enforcement of such ordinance the chances of locating the leaks are greatly increased and the unfairness to the city and contractor of making holes in the pavement without adequately repairing them will be eliminated.

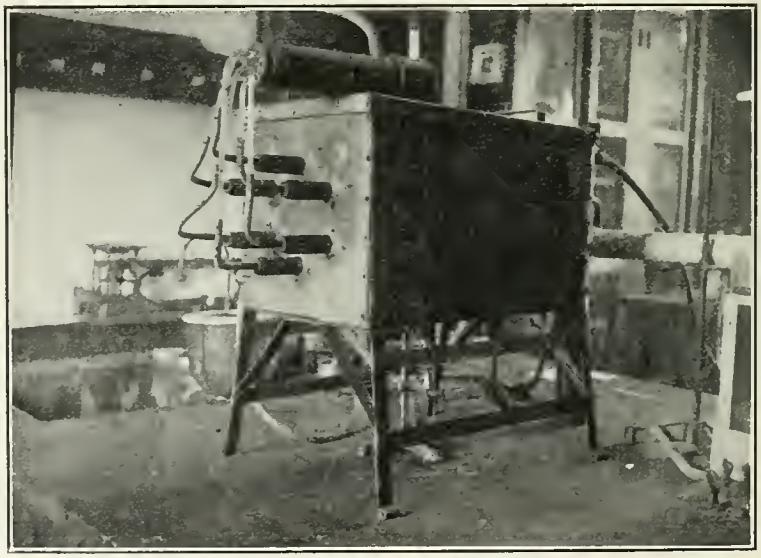
DISCUSSION

By S. R. Church, New York City.

THE destructive effect upon bitumens of illuminating gas, and also of the liquid that condenses from illuminating gas in the holders and mains, was first called to my attention during 1907, in connection with an investigation of the comparative value of various bitumens for waterproofing underground structures. At that time I conducted a number of laboratory tests along lines very similar to those described by Mr. Warren, and found, as he had found, that in an atmosphere of illuminating gas bitumens are softened very appreciably. I also found that the solvent action of the gas condensate, commonly known as "gas drips," on the bitumen, was very marked.

More recently, we have undertaken an investigation of the physical and chemical characteristics of a wide range of bitumens, including asphalts and tar pitches. That portion of the investigation dealing with the effect of illuminating gas on bitumens was conducted as follows:

Accurately weighed quantities of the bituminous material were placed in ordinary porcelain combustion boats and were exposed to the effect of a stream of illuminating gas flowing at a rate of 3.5 cubic feet per hour for six days. The tests were carried out in specially constructed iron tubes in which a temperature of 15 degrees C. was maintained by means of a water jacket, and a burner controlled by a metallic regulator. The flow of illuminating gas was regulated by meter control,



VIEW OF APPARATUS *used to expose asphalt samples to stream of illuminating gas in the tubes shown projecting from the end of the water jacket heated by gas burners below.*

and by having the gas pass thru a definite opening of 1/64-inch diameter. At the end of the test the boats were removed, weighed, and the bitumen removed from the boats, run into small metal containers, and penetration at 77 degrees F. determined for comparison with the original penetration test of the bitumen.

The bitumens tested all showed increases in weight, varying from 0.1 per cent. to 4 per cent. As Mr. Warren has only given the results of his tests on one particular type of bitumen, I will not enter into a discussion of the comparative results at this time, except to say that bitumens vary greatly in their susceptibility to illuminating gas. However, as stated by Mr. Warren, they are all affected by it, and almost all of them show measurable increases in penetration. In some cases this increase in penetration was as much as 60 degrees Dow.

The solvent action of gas drip on bitumens was determined by carefully preparing films of uniform thickness, and measuring the time required for gas drip under a definite head to penetrate thru the films. I will not discuss the details of this test at present, except to say that here also the bitumens were all affected, but some failed much more rapidly than others.

We expect to publish the results of our investigations before very long, and hope that a consideration of the results will lead others to undertake a study of the comparative resistance of different bitumens to the effect of gas. As Mr. Warren has pointed out, this is a very important matter, and sufficient attention has not been given to it.

Cleaning Bituminous Streets Without Sprinkling.

By Walter F. Slade, Commissioner of Public Works, Providence, R. I.

This note regarding the method of street cleaning in use in Providence, R. I., and the accompanying discussion by Mr. Warren, discuss a very important subject and one on which there has been much difference of opinion. The success of the method here described depends largely on the paving conditions and the care with which the process is applied, as set out by Mr. Warren.

THE fact that bituminous pavements laid in the city of Providence are not sprinkled with water is a subject that has occasioned frequent comments on the part of visitors to this city who are interested in the maintenance and cleaning of such pavements.

I will say briefly that we are convinced that bituminous pavement maintained in good repair can be kept in a condition more satisfactory to all classes that travel the streets, both afoot and in vehicles, without, rather than with, using water for sprinkling.

We keep them clean by the patrol system, and reasonably free from dust. We believe that the use of water has an injurious effect upon the durability of the pavement. It emphasizes every slight depression and gathers and retains the fine particles that collect on a street, creating an unsightly appearance and a muddy, slippery condition. This results in the skidding of automobiles and a vast increase in the number of accidents.

By keeping the pavements free from water we escape another prolific source of complaint. Upon the best of pavements there will be depressions sufficient to retain a thin sheet of water. The rubber tires of the swiftly moving auto, and especially the auto truck, will act as a syringe and force the muddy water in a small stream upon the clothing of any one passing along the sidewalk, and even across the sidewalk, covering windows and buildings with muddy spots.

That more might be learned upon the

action of water as affecting the durability of bituminous pavements, it would be instructive to bring out the results of laboratory tests, and a comparison of the condition of streets laid about the same time, where water was used and where not. The whole question is a subject worthy of the earnest consideration of all officers that have charge of the maintenance of bituminous pavements.

DISCUSSION

By George C. Warren, Boston, Mass.

COMMISSIONER SLADE has presented one of the shortest and what, to my mind, is one of tbe most important, comprehensive and useful papers which this convention has received in many years.

From seven years practical trial the city of Providence has practically proved what I believe to be a fact, that street sprinkling, as it is quite generally practiced, is worse than a useless expense. In fact, I believe it to be a relic handed down from past generations and conditions. Providence, a city having a population of nearly if not fully 200,000, has all kinds of street pavements, and scarcely any city in the country has them in as uniformly good, cleanly condition. Commissioner Slade tells us that this has been accomplished absolutely without sprinkling for seven years on all kinds of pavement, except that water-bound macadam is occasionally sprinkled with oil or oil emulsion. That is an object lesson which other municipalities will do well to emulate.

Fifteen years ago, when most of our street surfaces were macadam and dirt and the comparatively few modern pavement surfaces were intercepted by macadam and dirt roads, and traffic entirely horse-drawn, the sprinkling of pavements to keep down the dirt was essential. Since then there has been a rapid evolution until now much the greater percentage of traffic is motor-driven and rubber tires, which make no dirt. The great majority of the pavement surfaces of our city streets now consist of some form of modern, nearly waterproof pavement. And still we follow the old antiquated custom of keeping the little dirt wet down with street sprinklers, providing a muddy, nasty surface which cannot be thoroughly cleaned and necessitates more sprinkling and more mud until the gutters become receptacles of mud, and, if the pavement surface ever gets dry, the hue and cry go up, "Where is the sprinkling cart?"

We not only have the benefit of the seven years' experience of Providence, but we have our own country roads for an object lesson. Last week I took a 250-mile automobile ride over the bituminous surfaced country roads of Massachusetts, which have never been sprinkled, and most of them never cleaned. There had been no rain for at least three weeks and I did not find a dirty road on the entire trip. A week before I had a similar experience over 100 miles of bituminous road surface in Connecticut. This, notwithstanding that the country road surface is generally only 16 feet wide, with a similar width of dirt "shoulders' on either side, while our city streets are paved with a naturally clean surface from curb to curb. Why is this? It is simply because, without wetting down the dirt as fast as it forms and thus causing it to accumulate, as soon as an imperceptible dirt particle forms on the road surface it is picked up by the natural wind and rapidly moving automobile and thrown aside and in such small quantities that it is imperceptible and unnoticed and therefore does no harm.

Another important point is that if bituminous pavement surfaces are dry and clean the oil which drops from automobiles is quickly spread by auto tires to an extremely thin sheet which not only preserves the pavement but the slight amount of oil takes up the fine dust and materially helps to prevent the pavement surface

from ever becoming dusty. If the pavement surface is wet these valuable effects of the slight dropping of oil from automobiles is entirely lost.

Of course, in the case of city streets it is necessary, as Providence has done, to inaugurate a daily patrol system of street cleaning to pick up the horse droppings before they can become converted into dust, and to work around the intersections of unpaved streets, if any. Some one or more of the systems of pneumatic cleaning machines, now in the process of development, will surely soon be a practical success, but until then street washing at night is necessary under some conditions, but not generally so. I believe that such a system of dry cleaning by hand patrol is less costly than the antiquated street sprinkling, supplemented by the street sweeper trying to do the impossible—thoroly pick up the accumulation of mud. Even if dry cleaning were not cheaper, its greater efficiency in keeping street surfaces in better condition for use by automobiles, horses and foot passengers, merits its adoption, to say nothing of the far greater durability of all forms of street pavement surfaces when dry than when wet. It is generally conceded that water is the worst enemy of all pavement surfaces. When the water is applied in the form of wetting down an accumulation of dirt subjected to steel-tired traffic, we have the condition which from all ages has been known to wear the hardest steel and is therefore used in the grindstone and for sawing stone—to wit, the application of mud under a grinding process.

While some forms of pavement are doubtless more affected by water and mud than others, it injuriously affects all classes of pavement, and I will not except stone, even granite blocks, the wearing of which to a "turtle back" surface I believe to be primarily due to slight absorption of water.

I believe that repairs required to all classes of pavement are more generally the result of wetting down the dirt, leaving the surface in a continually more or less muddy condition, than by the traffic, or rather what would be the traffic under dry, cleanly conditions. A city or street in or on which sprinkling or other method of continual wetting of the pavement surface has not been practiced is almost universally one where the pavements are the best of their kind, no matter what form of pavement construction is used.

Washington, D. C., has the enviable reputation of having the most durable pavements of all kinds. For many years the system of cleaning in Washington has been hand patrol without sprinkling, except a very light sprinkling—just enough to lay the dust but never to convert it into mud—immediately in advance of the night sweeping.

Fifth avenue, New York, is always dry, except during rains, and we find one of the most durable asphalt pavements in the world. Fifth avenue provides an excellent single example of the lack of necessity of sprinkling any street however much traffic it carries. The traffic on this avenue is so concentrated that it would be impracticable to run sprinkling wagons over it even if the city desired to do so, and yet the pavement is always clean and never dusty.

A simple object lesson is the fact that when, contrary to a practice of keeping pavement surfaces continually wet down by sprinkling wagons, a portion of the surface has become dry for a time, it is found to be clean, while the still wet portions of the surface are still covered with a nasty, slimy, slippery mud.

The asphalt pavement on Alexander street, Rochester, in the laying of which I was plant foreman, in 1884 and 1885, is still in existence, and has a record for low cost of repairs which has been repeatedly referred to in reports to this association, and has until quite recently been free from street sprinkling. I was in Rochester about ten days ago and found the sprinkling cart has gotten in its work on Alexander street, and it is now rapidly deteriorating. Rutger street, Utica, laid in 1886, has been thru a similar experience of no sprinkling. Michigan boulevard, Chicago, from Jackson boulevard to Tenth street, paved partly with creosoted wood blocks and partly with asphalt, was always in dry condition and carried a very heavy traffic for ten years, and was in good condition when,

about four years ago, it was removed on account of widening the street, necessitated by the great increase in volume of traffic.

The bituminous pavement on Michigan avenue, Chicago, is now nearly five miles long. By actual count on July 26, 1912, it then carried a daily traffic of 11,425 vehicles, which has probably now increased to at least 14,000 vehicles per day. The pavement surface is always clean and never cleaned or sprinkled other than patrol cleaning, except as to narrow strips, about four feet wide, which are sprinkled and hand-broomed at night to remove the slight dirt which naturally collects near the curb. Other boulevards in Chicago are similarly treated, and confirm what is said above regarding New York City and further confirm the experience of Providence and the statement made above that a modern pavement surface requires little cleaning and will always be clean if it is only kept dry and hand patrolled thru the day.

I hope the day is not far distant when our cities generally will adopt a modern system of street cleaning without sprinkling, following the recent revolution from dirt streets to modern pavements and from horse-drawn to motor traffic. Providence has led the way. Other cities will do well to follow.

Vitrified Brick Street Construction.

By Will P. Blair, Cleveland, Ohio.

EVERY practical precaution must be taken to preserve the sub-base in a continued dry state to a depth below the probable frost line. If there be no frost line, the requirement of drainage is not so essential, the reason for the drainage being, to provide against expansion and rupture which follows with low temperature if moisture is present. For the purpose of securing a dry condition of the sub-base, it is useless to drain with little fall or to carry any great distance a supply of water underneath the pavement. The water from underneath the pavement must be carried thru transverse or triangular drains as quickly as the greatest fall practical will permit. From a slow-moving flow by capillary attraction the moisture is drawn up into the soil or earth and the drain is of no use whatever. The surplus water must be carried to points of disposal thru tile side drains or sewers located as far distant from underneath the pavement and as far below the frost line as possible. Only in this manner is it possible to eliminate the injury to pavements due to low temperature and much of that due to high temperature.

If the sub-base is dry, it furnishes a better support. If a concrete foundation is used, such drainage will prevent the intermittent wet and dry or contracting and expanding, that cracks and ruptures. During seasons of very high temperature, it takes away the hazard of a rupture from the expanding force of heat and steam.

A crown in a street serves but one purpose—that of surface drainage. What little therefore is needed for that purpose had better be provided in the artificial foundation with a flat bottom and crowned top.

The sub-base, once made, let it remain so. It should remain as a permanent and everlasting investment undisturbed, and not as is sometimes unfortunately the case, injured by hauling over it materials that go into other parts of the improvement. It is a crime to utterly destroy this part of the improvement before the public has any use of it whatever.

For reasons given for a uniform sub-base corresponding with that of the finished street, the concrete base must be finished likewise. This is easily accomplished as illustrated by making the mix sufficiently wet to be spread with the back of a dirt shovel or a shovel made for the special purpose and slightly heavier. (See

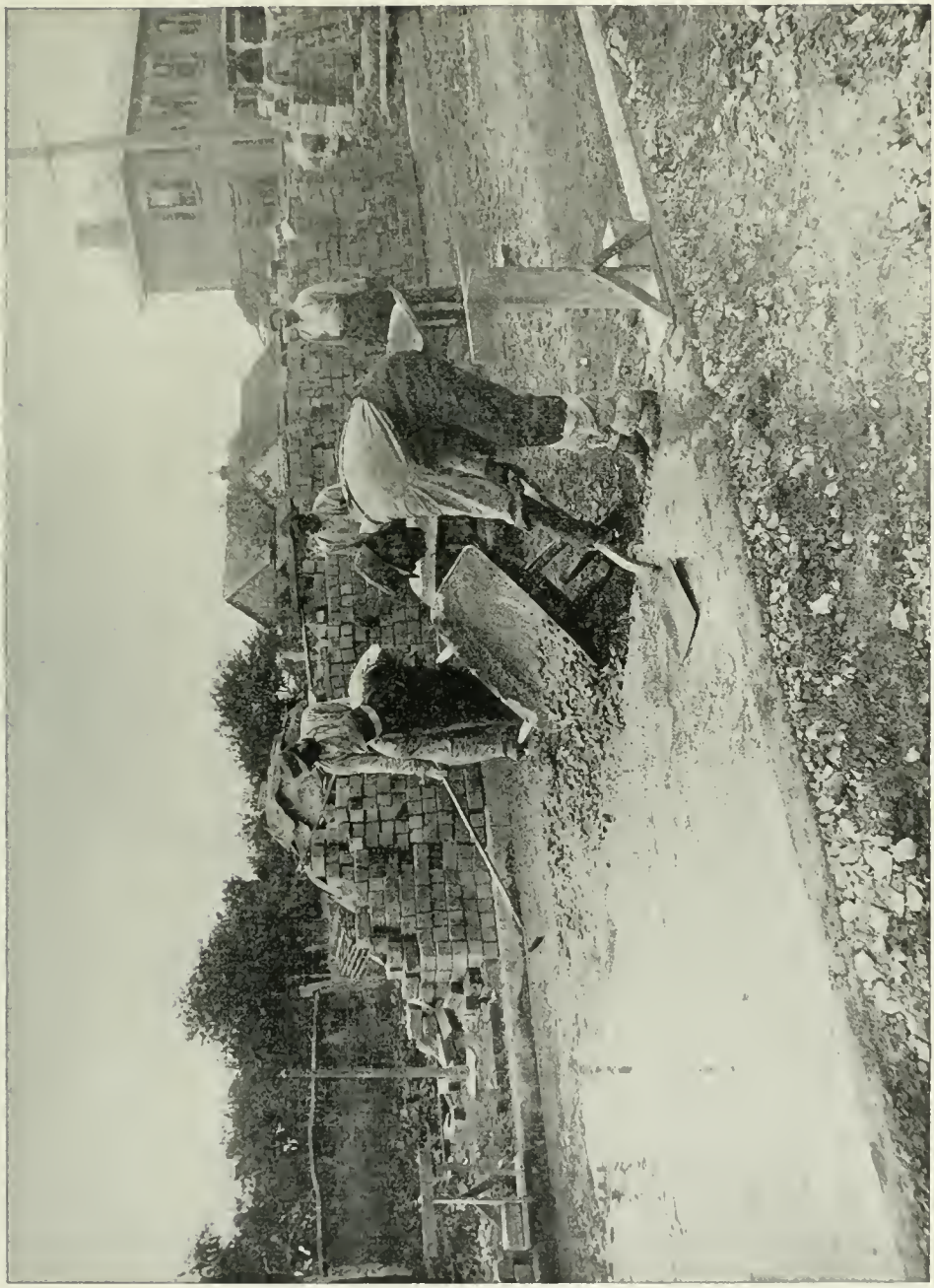


Fig. 1. Consistency of concrete required for best results.

Fig. 1). A guide template is greatly to be preferred over stakes to test the accuracy desired for a smooth grade and cross section.

The proper application and function of the sand cushion overlying the foundation base seems to be little understood; many specifications do not require it to be rolled and when it is provided for, but little importance is attached to it. Two real fights between the contractor and the engineer and many disputes over the interpretation of the requirement for rolling and compression of the cushion took place in the presence of the writer this season. The sand cushion must be made to furnish a uniform and even support to the wearing face of the brick that is to be built upon it. Its compaction and uniformity must be accomplished before the brick are placed upon it. It must be rolled, possibly dampened and re-rolled, struck off and re-rolled and depressions filled until it presents an approach to a solid or at least reduces to a minimum the voids in the sand. (See Fig. 2). A mere smoothing of the top of the sand cushion, affording a support here and there, will not suffice, nor will it do at all to depend upon compressing this cushion as an incident to rolling the brick. The attempt to roll the sand cushion transversely over the crown is almost fatal to good results. It is unnecessary that the quality of the sand for this cushion should conform to either purity, sharpness, fineness or even freedom from soil. Uniformity in its character and freedom from refuse and pebbles is essential. Suitable sand for the cushion therefore is readily obtainable at reasonable cost in all parts of the country.

Whatever may be said of the durability of the brick in their service as a wearing surface, it is well to bear in mind that the entire preparation of sub-grade, foundation and all else ready for the reception of the brick by the exercise of care, both in the preparation of the specifications and in their execution, the work thus far may be regarded as a permanent part of the improvement. If proper care is exercised as to detail, it would be a most remote happening that any part of the work should sustain an injury and necessitate a repair in any way. It is highly important therefore and surely in the interest of economy that all details of the plan be carried out to the utmost and the plan itself be such as to include in it everything necessary.

It is well known that many things of a mechanical nature are only best done in one way. Certain it is that placing the brick on the sand cushion can only be done best in one way—the best edge must be uppermost.

The brick must be placed for the dropper or brick layer so that this result will follow as a matter of fact in the natural way of picking it up and dropping it in place. Someone else must place them in readiness for this operation and that duty must devolve upon the laborers who bring the brick to him from the pile along the street. The practice of first dropping the brick into the street and depending afterwards upon taking them out and turning them over should no more be allowed than a mason in building a wall should first place a brick the wrong edge out for no apparent reason than to provide the necessity of relaying it. In street work, turning the brick disturbs the sand cushion and in wall work the mortar bed is injured, and in case of both the value of the construction is greatly lessened.

The brick must be clean when placed in the street. I recently knew of a case where the contractor having been on his job almost daily, allowed his men to throw dirt during the excavation process upon the brick, disregarded the fact, and put the brick into the street unwashed. On the completion of the street, the contractor was so proud of it that he invited the writer to go over it with him to inspect it. It did look good and I did not have the courage to say to him that the bond would shatter and the street would be greatly marred in appearance and lesser value made apparent. In less than a year's time the bond of the cement filler was broken and the abutting property owners are contesting the payment for the work. The contractor was one old in experience but he had not learned that a film of dirt will prevent the cement filler from adhering to the brick. It is needless to say that the neglect here lay equally upon both contractor and engineer. As a matter of

Fig. 2. Thoro compression of sand cushion essential.

economy, the brick should be placed at right angles with the curb line. I have no patience with the fancied theory that brick or stone lying in the street north, south, east or west or in picture form, adds to or detracts from their wearing value. It is the physical advantage for resisting wear, impact and elements of natural climatic effects that counts for economy in road construction.

It does seem an easy matter to follow our well-known directions for the application of cement filler. The trouble does not lie with a lack of understanding or that it is difficult. Failures result from a disposition to do it some other way so that negative directions seem almost necessary as well as positive ones. The object of the filler is to unite the brick units and make the pavement monolithic and thus reduce the wear practically to one of friction and distribute the load to the widest era. It must therefore be hard, tough and adhesive and as nearly impervious as possible and of uniform strength. To secure these qualities we find:

The mixture must be one to one of fine sharp sand and the best quality of cement.

That it must be mixed and applied to maintain these proportions in place.

That it must be applied to a dampened brick surface to make it adhere.

That it must extend solidly thru the entire interstices of the pavement.

It is impossible to call attention to all negative instructions or suggestions. Many things are done that ought not to be done which seem improbable. But a few days since, on a job where almost every step in construction approached the ideal, an intelligent appearing young man was found sprinkling the second coat of filler that had become slightly too stiff in shoving it forward in the second coat, washing off the cement coating from the sand particles instead of thinning by an intermixture of very thin consistency. A cement filler having been properly applied, do not expose it, do not allow it to be wrecked by an exposure to either extreme heat or violent changes of temperature. Cover it up and protect it so that in its setting, its maximum strength will result.

It is not expected this paper will do more than indicate the best practice in brick street and road building. I nevertheless trust I have succeeded in directing your serious consideration to the importance from the illustrations here given (Figs. 3 and 4). The one is a busy street built upon a concrete foundation of six inches and bearing as heavy traffic for eight years last past as can be found in our American cities of 200,000 population. The other, a street built upon the natural soil without an artificial foundation and bearing an average traffic in the residential district for ten years last past.

The importance of correct plans and proper execution of work where reasonable care has been exercised may be further appreciated from the results here given.

We have undertaken to measure the economic value of roads and streets for many years by merely naming them by the kind of predominating material of which they are made. In view of our presentation, I am constrained to say that it is a waste of time to assemble data for economic values unless you take into account the manner and method by which the road is constructed. A comparison upon any other basis is without value.

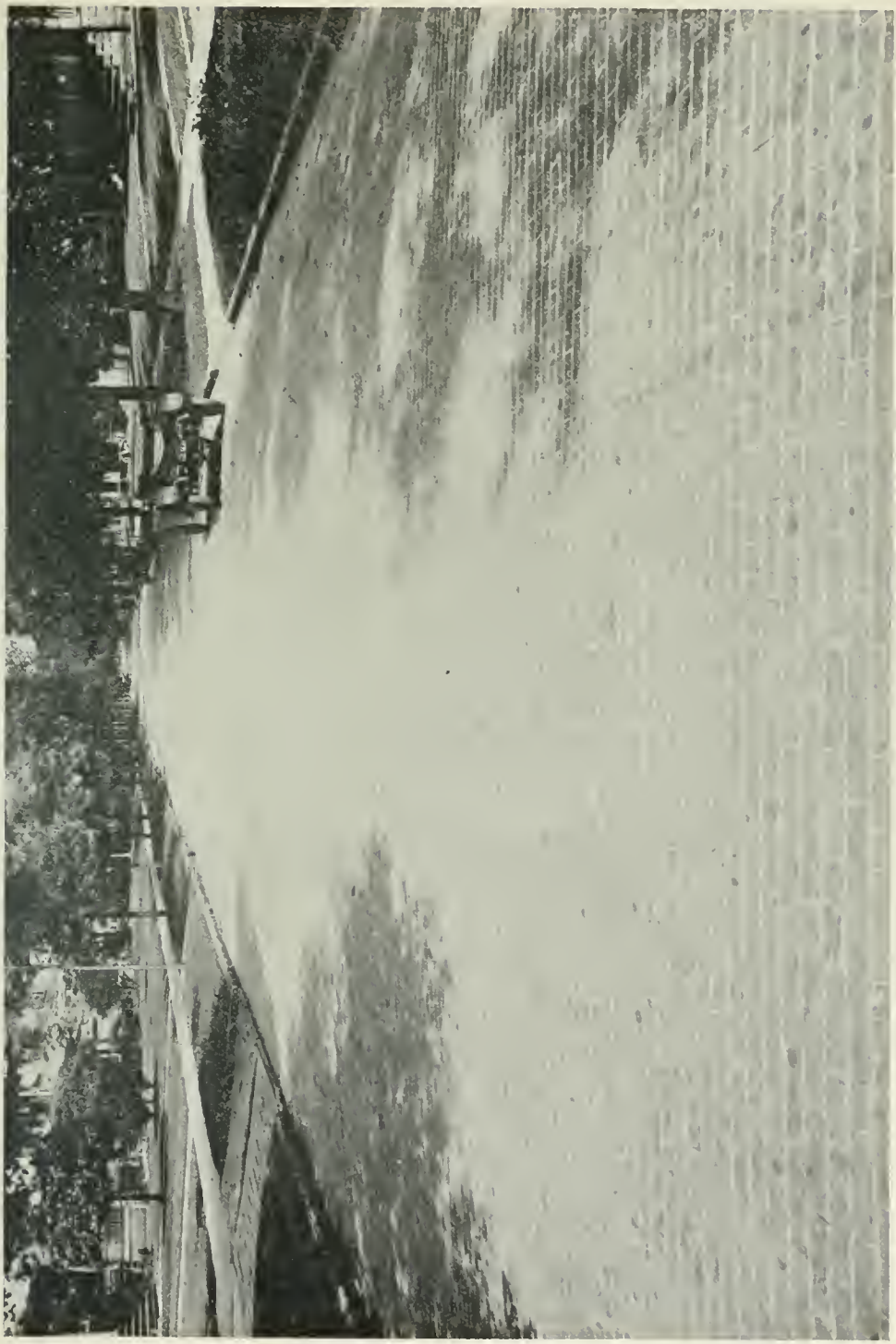


Fig. 3. A busy brick street on concrete foundation, eight years old.

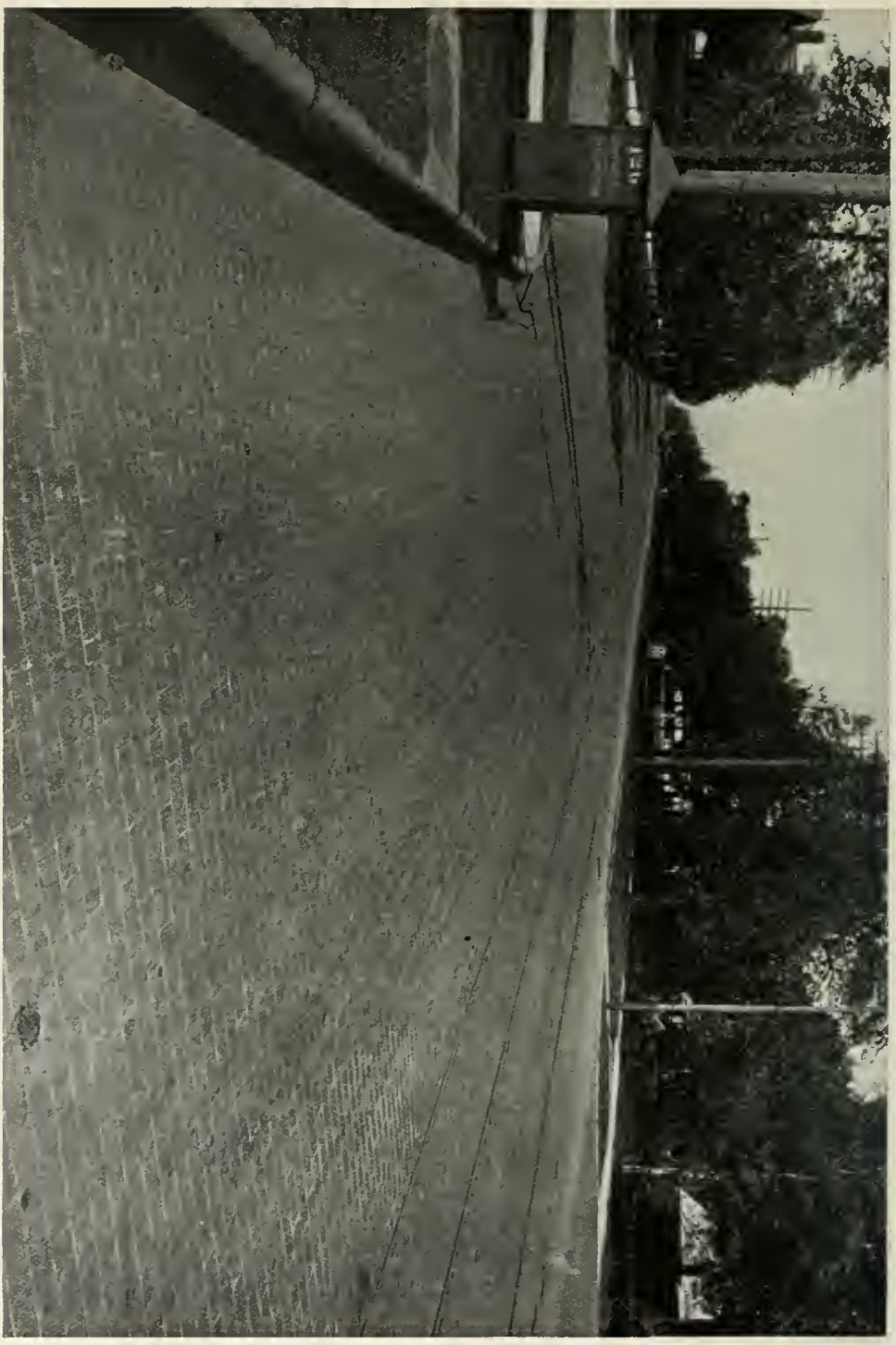


Fig. 4. A good brick street in residential district on natural soil foundation, ten years old.

CITY AND COUNTY HIGHWAY DRAINAGE

By Frank Reed, Los Angeles, California.

Corrugated iron and concrete are the two most popular materials for constructing drainage channels under roads and railroads and like purposes in California, and this article is prepared after a careful study of the conditions of such work in Southern California, where flood emergencies call for special characteristics. It also gives the results of experience under ordinary city and county highway conditions.

DRAINAGE is as much a question of economics as of engineering. Economics makes engineering interesting by placing a dollar doubt beside every assumed balance of forces. When such doubts are reduced, those charged with the wise distribution of the expenditures of a civic body enjoy peace of mind. Past experience is the best guide to the future, but not a perfect one. Destruction sometimes visits the works of the best of engineers. This may be because they have not foreseen the precise amount and intensity and mode and point of application of the destructive forces. More often they will have realized the possibility of their occurring but decide that the probability was so slight that it would cost too much money to provide a structure able to resist the attack.

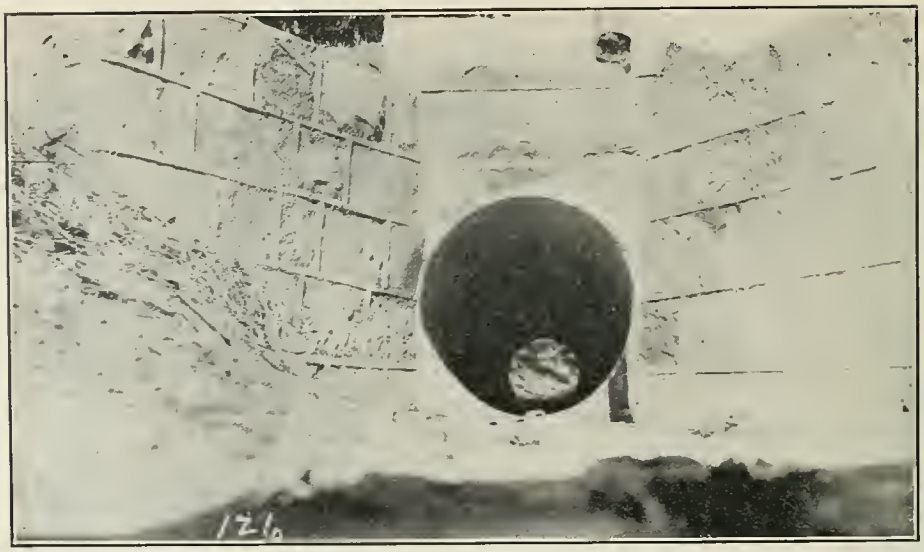
Decisions on type of structure in doubtful cases usually represent not alone the judgment of the engineer, but a composite of his judgment with that of the executive officials of the civic body who make the allotment of the budget. It is an important question, both of detail and of general policy, how far it is good judgment to go toward providing a structure which is strong enough to meet any possible stresses suggested by the experience of exceptional disasters, which occur only once in many years.

Annual charges on invested capital are a certainty. On the other hand, floods, for example, are variable from year to year. There can only be one greatest flood, and its like may not come again during the lifetime of the engineer, or the normal existence of the structure he has built.

The problem then is to insure a reasonably permanent structure at a reasonable cost. Of course, an ideal structure is one which not only provides a good margin of safety at a low proportionate expenditure, but which will behave well and permit of economical replacement, when subjected to the stresses, such as the floods that occurred last year in Ohio, and Indiana, and California, which good financial policy would not warrant the engineer in providing against with a structure of certain permanence.

Corrugated iron culverts behaved well in last year's flood emergencies. They stayed in place where everything else washed out. Elsewhere they gave a good answer to the question, "Suppose it does go, how much is lost in delay to traffic and replacement expense?" The big corrugated iron tubes rode down stream undamaged in floods, were dragged back with mules or horses and burled in earth and were carrying traffic in record time and with record economy. No special materials, no special outfit, and no special labor were required for their replacement. Just ordinary earth work, and ordinary labor to handle the teaming of the culverts, and of the earth work, and its shoveling and tamping. And the hasty temporary replacement became a part of the new and permanent structure. It did not have to be ripped out and wasted incidentally to the permanent repair.

So corrugated iron culverts and drains



CORRUGATED IRON CULVERT *near Montecito, Santa Barbara county, California, showing the attention paid to detail and appearance by County Supervisor H. S. Deaderich. This culvert is 3 feet in diameter and 34 feet long.*

have claimed special attention since these disasters, and investigation has brought out a greater appreciation of the ordinary, everyday good points, which have won for this type of structure a steadily increasing use and support among engineers responsible for the best type of city, rural and mountain highway construction, as well as by their professional colleagues in the steam and electric railway fields and elsewhere.

A series of questions were distributed by the writer among representative municipal engineers of California, where culverts get hard service tests, with the view of ascertaining their experience with, and judgment on the use of corrugated iron culverts. The replies, without exception, indicated their use during a sufficient time to enable users to come to a settled judgment, an increasing use of this type of culvert, and a state of satisfaction with it.

In drain and culvert practice, the round corrugated iron culvert has been installed in a great variety of conditions and sizes, from 8-inch to 84-inch, and gages of iron No. 16 to No. 10. Part circle culverts are meeting with an increasing use where side drains and intersections must be built in such a manner as to secure the necessary strength with the least possible depth of structure. They enable the engineer to take care of the flow of water by providing a broad rather than a deep conduit.

Features of this latter type of construction have been well described in an article by Mr. Paul E. Kressly covering his work as engineer at Inglewood, Cal.

In side drain work, situations where economy of the corrugated iron culvert and the ease of placing it are noticeable, are at intersections, with an interesting type occurring where the culverts are laid under the sidewalk across the corner, giving a clear, dry footway; under drives to abutting property; ordinary culvert construction for carrying streams and drainage beneath roads. Under these latter conditions, of course, the larger sizes of pipe, and usually the greater lengths are employed. Where it is necessary to work in a small vertical space, a part circle may be used, or, more easily, a battery of tubes of moderate diameter avoids disturbing the level of the highway. With the small tubes special care must be taken to avoid the risk of under-estimating capacity, as several small pipes are more likely to be choked at the ends with large sticks and stones, and carrying capacity for water is more likely to be insufficient.

In the West, where irrigating ditches present a problem to the county highway engineer, the inverted siphon of corrugated iron is giving splendid service. Experience has shown that it does not clog from muddy water, and in the event of a change of location of a ditch the culvert may be moved without loss of material to the county. It abolishes the nuisance of the high ditch crossing, and broken planks and constant maintenance of wood culverts, as has been the experience of Mr. F. E. Lester, highway commissioner, stated in a published report on the highway system built for his county of Dona Ana, N. M.

A few motor truck owners object to restrictive ordinances, some of which are possibly due to poor judgment as to what they start down a highway. A western gas company owns a truck which carried nine tons of material as far as a bridge and went thru the bridge, as they boast, "Without hurting the truck." Corrugated culverts used on highways have been subjected to big loads and frequent travel of trucks which were not foreseen when the highways were built. But the material has not only strength to resist compression, but elasticity which takes care of impact and the heavy dragging tension which characterizes the rapid passing of a truck. The strength is high in proportion to weight and gage, due to the corrugated form, as is likewise the elasticity. Equally satisfactory is the resistance to stresses from the inside, caused by freezing of water in the pipe in winter. As the pipes are joined together by fitting one section within the end of another, the joint has double strength, giving proper resistance to stresses from freezing, as well as external stresses, and preventing sections from separating and dropping out of line, due to washed foundations. If end walls are omitted, or inadequate, the end sections do not break off due to progressive washing away of dirt below the pipe. Experience has shown effects of poor filling and unskilled labor will be taken up to some extent by the pipe, as it will conform to some change in its foundation and surrounding earth work, without losing its roundness of section, and a slight sag does not cause choking. It is good in swamps, or quicksands.

The corrugations produce upon solid material passing thru the culvert in water an effect which prevents choking, and also reduces wear on the pipe. They maintain a state of agitation in the water which keeps, silt, etc., in suspension, while sand and sharp stones pass thru with a rolling rather than a sliding motion. The corrugations absorb expansion and contraction due to temperature, so there is no longitudinal thrust tending to break joints and disturb foundations and end walls.

Flow of seepage water immediately beneath or alongside the pipe, which, if present, would gradually drag out the foundations, is to a considerable extent prevented by the corrugations.

CORRUGATED IRON CULVERT *under a main street of Santa Cruz, Cal. This culvert is five feet in diameter and the water falls about five feet at its lower end.*

CORRUGATED IRON CULVERT *under Western Pacific Railway, near Altamont, Cal., 5 feet in diameter and 530 feet long, under a fill 85 feet deep. Two other forms of culvert failed prior to the adoption of the present American ingot iron corrugated circular form.*

On all highways where there is considerable risk of washout, and where the cost of the highway is sufficient to justify it, end walls or rather wing walls, which serve both to protect the ends of the culvert and to concentrate the flow of water, giving a larger capacity, should be used. Nevertheless thousands of culverts are installed, particularly in the rural districts, without any such protection, and under many conditions they seem to give perfect service.

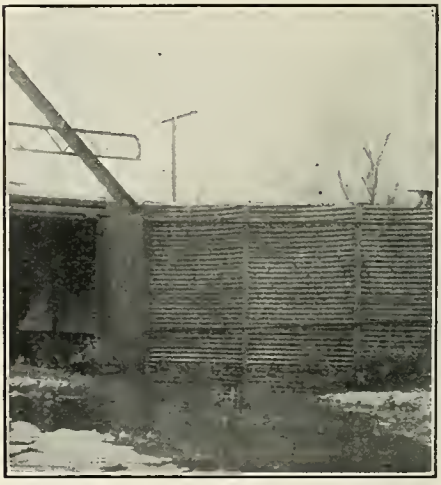
Having become accustomed to the use of corrugated iron in culverts and drains, municipal and county engineers have been experimenting with its application to other purposes, to which the form, and more particularly the durability of the material, make it especially adapted. Corrugated iron tube bridge piers filled with concrete have successfully withstood a flood test, remaining in place when all the rest of the bridge was completely carried out.

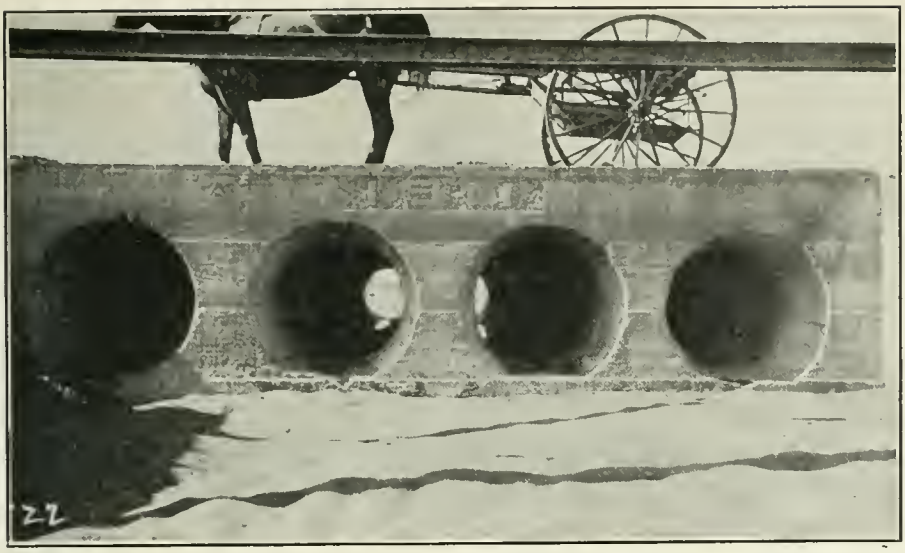
Corrugated iron arches are being used by some engineers as a flooring for I-beam highway bridges, the advantages being a considerable reduction of dead load, and economy in construction. All that is necessary is to fit the segments into the space between the I-beams and insure the permanence of the arch by setting the space between the I-beam and the lower part of the segment with grout and covering with road material and surface. The fact that there are no forms to remove (as is likewise true in the case of the part circle drains), reduces the cost materially.

The use of corrugated iron segments to protect the abutments of a bridge against washouts affords an economical method of guarding against this danger. That it is also effective is indicated by the experience in San Bernardino county, Cal., where this type of protection is employed, using plans of County Surveyor J. Shirley Bright, Jr.

Corrugated pipe as a protecting jacket for gas or water mains where these are subjected to traffic have proven highly successful. The Midway Gas Company used many thousands of feet of corrugated iron culvert pipe, 12 inches in diameter, to enclose their 10-inch smooth pipe used to conduct natural gas from the oil fields near Bakersfield to the city of Los Angeles. Whenever the line passed beneath a highway, street, or railroad crossing,

CORRUGATED IRON SEGMENTS *used to protect abutments of bridge against washouts near Chino, San Bernardino county, California. Samuel Pines, supervisor; J. Shirley Bright, Jr., county surveyor.*





FOUR PARALLEL CULVERTS *of American ingot iron, 2 feet in diameter, 30 feet long. Discharge capacity was increased nearly 15 per cent. by beveling the entrances in the concrete end walls.*

the corrugated jackets were used. The Southern California Gas Company, of Los Angeles, has also used this product in similar manner for encasing its distributing mains where traffic was encountered.

On account of its lightness, and the fact that the various sizes will nest one within another, corrugated iron culvert is easily stored and transported. Freight charges are comparatively low, and the cost of local distribution is likewise low, while in the case of small jobs or repair work, the lightness of the culvert makes speed possible in getting it to the point where it is to be used, as well as in the matter of installation. The pipe is delivered all made up and has simply to be rolled into place. If the total length wanted is too long to make its shipment in one length practicable, the fewest number of sections are used and the matter of field joints may be handled easily in several ways. In a busy highway, half the culvert can be installed and traffic can be passed over it while work is being done upon filling the other half. This is an advantage appreciated by the public, as well as by the authorities doing the work.

It is generally agreed that corrugated iron culvert, by its durability, strength, elasticity and other intrinsic advantages, shows a peculiar ability to make good in spite of defects in placing and filling of a minor character which always occur under the practical conditions of labor and supervision which prevail in road work. Engineers responding to the interrogatories sent out by the writer have given specific replies showing some of the mistakes which could be avoided. In the case of the part-circle culvert, they confirm the warning which is emphatically issued by the manufacturers, as well as suggested by engineering knowledge and common sense, that the sides should fit accurately against the abutting wall, preferably using angle-irons, so that the side wall will be true to line and grade. It must be remembered that the strength of this type of culvert depends almost wholly upon the firmness and rigidity with which its edges are held. Manholes should be left where needed for clean-outs, and culverts should not be made too shallow. Thoro tamping of back filling at the side of a round culvert, particularly the larger diameters, is a point to which careful supervision should be given. Culvert should be so installed that seams are on the sides, to

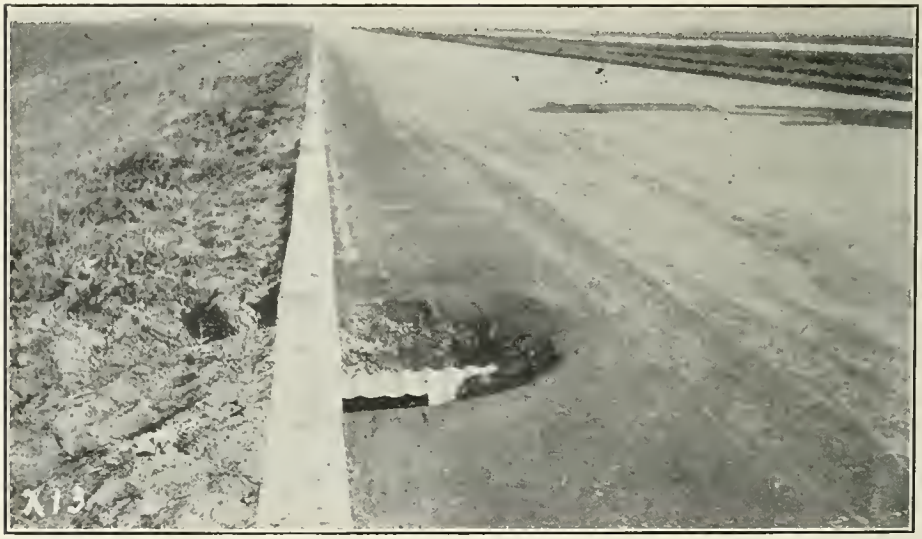
avoid having direct downward thrust bear on the rivets. Covering should never be less than six inches. This thickness or greater will so distribute ordinary loads that engineers are justified in claiming a guarantee from the manufacturer that proper gage will stand up.

The California Highway Commission and also various California counties and municipalities have adopted a plan assuring durable pipe in highways which would seem to leave no loophole for defective material to be slipped thru, as sometimes happens where pipe is required to be furnished by contractors along with other work. The direct purchase of materials of known merit and required standard is proving a success in California and elsewhere. Contractors unable to bid on work involving purchase of large quantities of material are often able to easily handle the same work efficiently if relieved from the necessity of making arrangement for large capital. The commission buys its own pipe, and along with other work lets out the contract for placing it under suitable specifications.

CORRUGATED IRON CULVERT *under improved roadway near Lankershim, installed by Los Angeles Suburban Homes Company, 10 inches in diameter. Note the opening under the gutter, 5 by 12 inches, cut to receive the gutter drainage.*

This precaution is dictated by the necessity of securing pure iron in order to have a durable pipe. Corrugated iron culverts, like most manufactured products, have seen their wild-cat days, and have been thru the period of over-promotion, prior to reaching their present status of time-proven standards.

The first corrugated culverts were very fortunately made of a very pure charcoal iron, and some of these are still in service in the neighborhood of Crawfordsville, Ind., and in good condition after eighteen years in the ground. After the very early days of pioneering the obvious good points of corrugated iron pipe culverts make it rather easy to sell them, and a good many people got into the business without really understanding what a pipe must be to give long service. Under the influence of too keen price competition and ignorance on the part of both manufacturers and buyers, a great deal of pipe was put in which rusted out rapidly and gave the business a severe set-back, from which it only recovered under the influence of new men and new and scientific methods. It is now recognized that the electrolytic nature of corrosion accounts for the rapid spotting and deterioration of corrugated iron pipes which contain too large a percentage of impurities. This explanation has been accepted by prominent authorities, including the leading tech-



CORRUGATED IRON CULVERT *at street intersection in San Bernardino, Cal. One of many part-circle culverts, specially adapted for such work, where depth is not available.*

nical journals. The tendency of physical science for the past ten years has been to establish the fact that all chemical actions are, in their essence, electro-chemical. The electrolytic corrosion of iron and steel is by no means an isolated or peculiar phenomenon, but is found to be of the same basic nature as the most familiar reactions. The subject has been thoroughly threshed out since the important investigation in 1905, by the U. S. Department of Agriculture, which led to the conclusion that fence wire which deteriorated rapidly did so on account of the presence of segregated impurities, while wire which actual experience showed to have a long life, was very nearly pure iron. It was determined that the purity of the iron was the direct cause of the long life. Corrosion of the short-lived specimens was due to the presence of material occupying a different position from iron on the scale of electro-potential, thus tending to create an electrical condition which favored the oxidation of the iron at points contaminated by the presence of the foreign metal. Pure iron pipe has been used in alkali country and in localities where a considerable variety of mineral substances were present, and has shown a marked superiority in behavior, as far as is noticeable, being unaffected under the influence of alternate washing and drying, warmth and cold, etc.

The proportion of foreign substances in even the lower grades of steel which have been used sometimes in culvert manufacture is very small, and slight variation produces a very considerable change in the ability of the metal to resist corrosion. Formerly the sulphuric acid test was used to detect presence of impurities, but this test does not operate in iron which has been treated with a little copper. Engineers are safe in getting out a specification which goes to the heart of the matter. As pure iron is the metal which lasts, tho absolute purity is impossible, the thing to do is to fix upon the percentage of impurity which can be allowed without promoting deterioration of the pipe, and which is obtainable without undue cost in manufacture, and specify that or greater purity, and get a suitable guarantee. Of course, there is more to a culvert than the raw material. The treatment, including the galvanizing, which is done with a high degree of perfection on some of the culvert in the market, demands careful consideration. So does the assembling, including the width of overlap, which should be sufficient to give a firm joint, and the riveting.

THE COLORADO STREET BRIDGE

AT PASADENA, CALIFORNIA

In the new Colorado street bridge at Pasadena, Cal., the application of structural forms to the design of a concrete structure has been carried so far that engineers are watching the bridge with interest. The pronounced curve near one end adds another item of interest. The engineers have made every provision which their science presents for the action of forces of all sorts which might be applied, and the result will doubtless be a confirmation of their judgment.

ONE of the most pronounced examples of application of structural forms to reinforced concrete is the Colorado st. bridge over the Arroyo Seco, on the city limits of Pasadena, Cal., which was constructed between June, 1912, and December, 1913, and is now in regular use.

The accompanying photographs show the light and graceful appearance of the bridge and its effect upon the landscape, which is one of the most striking in Southern California.

The bridge has nine main arch spans and approach spans at each end broken into three short arches, each of 30 feet span, counting eleven main spans in all, with a total length of 1,467.5 feet, including these approaches. The roadway is 28 feet in width with a 5-foot sidewalk in each side. The longest span, over the main bed of the Arroyo, seen in all three of the accompanying photographs, is 223 feet between centers of piers, and the sidewalk on it is 150 feet above the bed of the water course.

The contract price of the bridge was $187,700, and the total cost, including engineer's fees and extra work, was about $202,000.

Waddell & Harrington, consulting engineers, Kansas City, Mo., were the designers of the bridge and supervised its construction by the contractors, the Mersereau Bridge and Construction Co., of Los Angeles, Cal. We are indebted to L. C. Smith, city engineer, an article by J. C. Wright, chief engineer for the contractors and others for the information and photographs on which this article is based.

The curve in the line of the bridge is a point of interest in the design as well as in the architectural appearance of the bridge, and was used to make the most economical crossing of the Arroyo possible under the existing conditions. The independent foundations for the ribs of the arches and the consequent concentrations of stresses, made the design comparatively simple. The method of tying the tops of piers together, as well as the arch ribs at fixed intervals, is seen clearly in the photographs. The roadway was paved with asphalt and an unexpected difficulty developed in the curve, the pavement becoming very slippery after a light shower. Three wrecks in fifteen minutes is one reported record, all caused by the skidding of automobiles on the curve. Tests showed that the curve is safe at any speed under the legal maximum of ten miles an hour but is dangerous at any greater speed. Flushing the pavement so as to keep it clean, stopped the skidding at reasonable speed. A contributing cause, in one direction, to this difficulty is the gradient of the roadway, which is uniformly 2.655 per cent. from end to end.

The two arch ribs are located under the curb lines of the roadway and the sidewalks are supported on cantilevers or

brackets. Over each pier is a recess projecting beyond the outside of the sidewalk, having the appearance of a refuge. The bridge is lighted by two five-light ornamental electroliers at each refuge, these posts and their concrete bases being the only projections above the line of the balustrade.

The city of Pasadena paid half the cost of the bridge and the county of Los Angeles the other half, as it forms the connecting link between Colorado street, the main thorofare of Pasadena and one of the main highways in the comprehensive system of roads improved by the county. Before the bridge was constructed these two highways stopped abruptly at the tops of the bluffs, the ends being about 1,500 feet apart. Narrow, zigzag roads down the bluffs made a very unsatisfactory connec-

COLORADO STREET BRIDGE, *Pasadena, Cal., showing the roadway and lighting system and the character of the roadway and sidewalk traffic.*

COLORADO STREET BRIDGE, *Pasadena, Cal., giving a side view of the entire bridge, with the curve at the right end.*

COLORADO STREET BRIDGE. *Pasadena, Cal., showing the main 210-foot span and the height of the bridge above the bottom of the Arroyo.*

tion, which was badly served by an old timber truss over the water way of the Arroyo.

The curve in the plan of the bridge has a radius of 916 feet, using the center line of the roadway, and a curvature of 52 degrees. Mr. Wright's description of the lay-out of the curve is as follows:

"The center of each pier is on a radial line. The piers are so constructed that the difference in length of the two sides is taken up in them, the two ribs of the arches being identical. This gives each pier a trapezoidal shape. The piers are not solid from face to face of bridge, but a separate pier is constructed for each rib; the separate piers being connected below the springing lines by concrete arch diaphragms 8 feet in width, well reinforced and braced against torsion. The tops of the piers are tied together by braced girders. On the curved portion of the bridge, the entire curve is taken up in the railway and floor system and cantilever brackets, the remaining portions of the piers and arches being constructed on rectangular lines.

"The arches for the 105, 140, and 210-ft. spans are of the fixed type with parabolic intrados. In the 105-ft. span, each rib is 2 ft. deep by 3 ft. 8 in. wide at the crown and 3 ft. 6 in. deep by 4 ft. 8½ in. wide at the springing line.

"In the 140-ft. span each rib is 2 ft. 6 in. deep by 4 ft. wide at the crown and 4 ft. 6 in. deep by 5 ft. 10 in. wide at the springing line. In the 210-ft. span each rib is 3 ft. 8 in. deep by 5 ft. wide at the crown and is 6 ft. 4 in. deep by 6 ft. 6⅜ in. wide at the springing line.

"The arch ribs in each span are tied to each other by six tie beams, placed at regular intervals in the span and at the crown by a cross girder of the floor system. The deck system is of the type known as hollow spandrel construction. Each span is divided into ten panels by cross girders, supported by columns resting on the arch ribs. These cross girders in the 105-ft. span are 14 by 45 in. except at expansion joints where they are 14 by 69 inches.

"In the 140-ft. span the girders are 16 by 53 in. except at expansion joints where they are 16 by 74 in. In the 210-ft. span, the girders are 20 by 63 in. and 20 by 80 in. respectively. The floor slab on the roadway ranges from 9 to 11 in. thick in the various spans."

BUILDING AUSTRALIA'S NEW CAPITAL

By W. D. Hornaday, Austin, Texas.

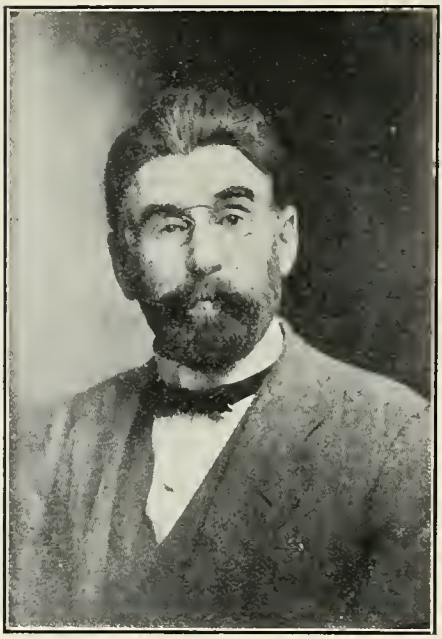
This description of the plans for the new capital city of Australia and the progress in construction show the part which city planning art in the United States is to play. Australia is on the eve of a rapid development which may bring the completion of this project earlier than is now generally expected.

WHEN I stood on the almost unoccupied and barren site of Canberra, the future great capital city of Australia, it was easy to bring to my mental vision a picture of the possible future appearance of the population and government center that will in years to come cover that undulating plain and valley. Perhaps another Washington or a second Paris, or a modern counterpart of some other great capital city, may occupy that chosen site. Australia is destined to become one of the great nations of the world. It is unreasonable to think that that far-away island-continent, with potentialities that are almost unsurpassed by any of the growing countries of today, will always remain a colonial possession of Great Britain.

When the federation of the six states and territories that comprise the area of Australia was effected in 1900 and a national government thereby established, it was provided that the capital should not be located in any of the existing cities and towns, but that it should be newly established from the ground up.

It is interesting to note that the bringing about of a union of the independent political divisions of Australia and particularly in the accomplishment of many of the preliminary details relating to the location and building of the capital city for the commonwealth, one man of the progressive American type was the most important factor. This person was King O'Malley, who occupied the high posltion of Minister of State for Home Affairs during the time that the selection of the capital city and the plans for the future great metropolis were under consideration. Mr. O'Malley comes so near being an American by birth, sentiment and action that he is quite generally put in that class of nationalities by the people of Australia. He was born in Canada just across the line from Vermont. He became a resident of the United States, however, when a youth and he lived in this country for many years and until he was sent to Australia as a representative of a life insurance company. There he soon became affiliated with the union labor cause and has been ever since probably the most influential leader of that element, particularly in its political operations. Mr. O'Malley became Minister of State for Home when the Labor party obtained control of the government a few years ago. That party is now ousted from power. Mr. O'Malley is still a member of Parliament, representing a strong labor district in Tasmania. He has impressed his Americanism upon many of the laws of the commonwealth.

It is but natural that it gave Mr. O'Malley no little pleasure, while he occupied the position at the head of the Home Affairs Department, to acept the design of W. B. Griffin, landscape artist of Chicago, for the laying out of the proposed federal capital city. This was a competitive award, Mr. Griffin receiving a premium of $8,750. The designs for the plan of the capital were called for by the commonwealth government in April, 1911. Landscape artists from all over the world entered the competition, a total of 137 designs being received. The board that was appointed to pass upon the competitive



KING O'MALLEY, *a former citizen of the United States, under whose administration the location of the capital was secured and by whom the site was selected.*

plans was unable to make a selection and it devolved upon Mr. O'Malley to make the award.

On acount of the long-standing jealousy that exists between the cities of Sydney and Melbourne and to a more or less degree between the peoples of New South Wales and Victoria, the proposition of establishing a commonwealth government and the creating of a national capital was strongly opposed in certain quarters. Finally, in order that New South Wales might be brought into line, it was stipulated in an act of the constitution of the Australian commonwealth that the seat of government should be determined by Parliament and should be in the state of New South Wales and be distant not less than 100 miles from Sydney. The location of the proposed Federal district and new city were decided upon in 1908. They are in the southern part of the state of New South Wales.

It was on March 12, 1913, that the foundation stones of Canberra, which is the name selected for the national capital city, were laid. The ceremony was impressive and full of official splendor. Among the noted guests were Lord Denman, the Governor-General of Australia, Lady Denman and many of the higher officers of the Commonwealth government. Notwithstanding the remoteness of the locality and the lack of a direct railroad transportation outlet at the time, nearly 5,000 people witnessed the cornerstone ceremony. Of these about 500 were specially invited guests. The brilliancy of the spectacle was enhanced by the presence of about 1,000 colonial troops. The name of the future city was kept a secret. It was left to Lady Denman to confer the title upon the Federal municipality. She carefully guarded the name and did not make it public until that part of the foundation ceremony had been reached when she was called upon to pronounce the name, Canberra, by which it was hereafter to be known.

Yass-Canberra is the name of the district in which the new Federal territory is situated.

Since what is known as the commencement monument, which marked the beginning of the work of building the city, was erected, considerable progress has been made in laying out the capital on the magnificent lines that are embraced in Mr. Griffin's plans. The work at present is largely of an engineering character. Besides the city itself, the Commonwealth government proposes to make the federal territory one of the most modern in its arrangements that is to be found in any country in the world. In order that the commonwealth might have an unbroken outlet to the sea on the east, the Federal area extends to Jervis bay and embraces an ideal deep water harbor and site for a splendid port. It is proposed to develop this new port. This improvement of itself will be of vast benefit to the people of a big scope of territory in the states of New South Wales and Victoria. From Canberra to Sydney is 203 miles, via Quenbeyan, and from Canberra to Melbourne, via Yass, is about 434 miles. When the site of Canberra was selected that locality was not penetrated by a railroad. Since

then a line has been constructed which gives it a direct outlet to Sydney and Melbourne and intermediate points, and by the time the new buildings are erected and the new seat of government established there will have been constructed a railroad from Canberra to Jervis Bay.

Many things were taken into consideration in deciding upon the site for the capital city. From a climatic and health standpoint the Canberra section is unsurpassed in all Australia. The lay of the land, upon which the city is to be built, is specially adapted for carrying to fulfillment the artistic plans which Mr. Griffin has prepared. In the distance are ranges of low mountains, and the slopes of the plains enable the placing in effect of perfect systems of drainage. Every detail of the city that is to be, has been carefully considered and adopted. This applies to the conservation and distribution of the fresh water supply, to the construction of sewer and drainage systems, the laying out of streets, avenues, parks, public gardens and various other public works. Besides the ample supply of water for domestic purposes from the Cotter river, lakes will be created in the city by the construction of dams on the Molonglo river. It is estimated that the available water supply from the Cotter river is sufficient for a population of 250,000. This is exclusive of the catchment area of the Molonglo and Queanbeyan rivers, which may be utilized should the city attain a size demanding it.

All of the public utilities of Canberra, and other towns that are to be established by the commonwealth government on Jervis Bay, including the port, are to be owned and under the direct jurisdiction of the Federal government. Electric power will be generated on the Snowy river, transmitted to Canberra and other points in the Federal territory for domestic and industrial uses.

This city will be different in many respects from any municipality in the world. It is planned to make it not only a center of government for Australia, but to establish there institutions of art and learning and to create a social atmosphere among the people that will make Canberra re-

THE BEAUTIFUL SITE *of Canberra, the new capital of the Federation of the States of Australia.*

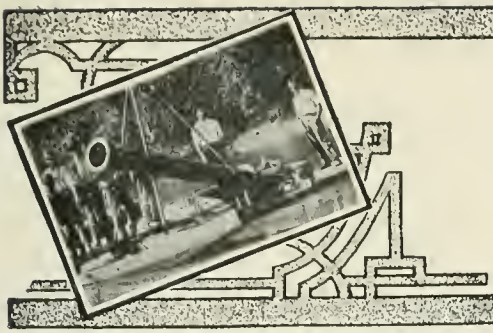
COMMENCEMENT MONUMENT, *marking the beginning of the work of building the Australian capital city of Canberra.*

nowned for its high standard of citizenship. Many millions of dollars are to be expended in the erection of the various government buildings. Every effort is to be put forth in selecting plans for these different structures that will be in full keeping with the landscape design and of the general modernness of the whole scheme. The furnishing of competitive plans for these buildings will be called for and architects all over the world will be allowed to compete. Canberra is to be distinctively a residential city outside of the functions of government that will have their headquarters there. None of the land embraced in the city itself, as well as that in the Federal territory, will be sold. It will be occupied under lease.

The commonwealth government will exercise jurisdiction in prescribing the character of improvements that lessees shall make and in many other ways a careful paternalistic policy will be practiced. It is proposed to utilize a considerable part of the lands outside of the city by locating what is known as closer settlements thereon. These colonies will be aided financially, and in other ways, by the commonwealth government in much the same manner that some of the state governments of Australia are now doing towards settlers upon smaller blocks of public lands. By leasing the land for homes and other purposes instead of selling it, there will be no room for speculation on the part of investors.

At the present time the population of Canberra consists almost exclusively of the administrative officers and force of laborers that are laying off the site and constructing the public utility systems that are to be in readiness for use when the building of the city itself begins. It will take probably several years—how long no one in authority ventures to predict—to complete the public works that are to be the nucleus of the capital. Whether the new city will grow rapidly in population is a matter that time alone can tell.

The layout of Canberra calls for the establishment of a civic and population center to be conveniently located with respect to the railroad station. Wherever possible, the cardinal idea of securing sunlight for the city blocks by planning them at suitable angles to the meridian, has been observed. The Vice-Regal and Prime Minister's residences are to be within easy access of the Parliament building and more ornamental spots of the town. The public office buildings are to be placed around the Parliament house so as to facilitate administration and to lend architectural beauty to the scene. The plans provide adequately for the buildings that are to be used for courts of justice, public worship, university, schools and school playgrounds, hospitals, ornamental lakes, avenues and boulevards, residential areas, lake drives, centers for distributing traffic, streets, facilities for handling freight, tramway system, bridges, provision for city expansion and various other features that go to make up a modern city. The public buildings will be of brick and concrete construction.



EDITORIAL

MUNICIPAL IMPROVEMENTS ARE NOT DIMINISHED BY THE WAR

There are many indications, which are increasing in strength and number daily, that this country is recovering from the shock produced by the declarations of war among European nations and the rapid progress of the war in its earlier stages. The world is beginning to realize that the war will probably last for a long time, and this is having a steadying effect, also. The trade so wantonly abandoned by the warring nations must be taken care of by others, and as time goes on the return of those nations to competition for that trade becomes less dangerous in point of strength as well as of time.

Timid nations and timid manufacturers are becoming daily more ready to go out after the trade waiting for them rather than to wait until it is forced upon them. The questions now are as to how to go to work. Foreign exchange, foreign advertising, foreign conditions of trade and credit, foreign customs and fashions and preferences as to goods and methods of putting them up, are all unknown quantities to the average business man and manufacturer of the United States, and some means must be devised to educate him in these respects. Much is under way for his benefit, but it will take time to put him in the way of shipping his goods to foreign countries with the additional capital probably necessary to begin the new line of credits and to supply the new line of agencies, exhibits and reserve stocks necessary to serve the foreign trade adequately.

Meantime, American business conditions, according to the indications, will be recovering more or less rapidly.

Particular attention should be called to one class of business which is but little disturbed, that of municipal improvements. As is usual in times of financial stress, many cities are proposing to do more than the usual amount of work, for the reason that they wish to reduce the number of

unemployed, and for the further reason that materials and labor under these conditions will probably be less costly and more can be done for the same money than in ordinary times.

Inquiries made of a large number of cities indicate that only a small percentage expect any interference from the effects of the war. Those which can use cash in hand or which can raise money on short time notes are specially busy, because they have no difficulty in getting all the money they want to spend at rates which do not eat up the savings above referred to. Those cities which must raise their money by the sale of improvement bonds are not quite so comfortable just now, because a considerable amount of money is being used to loan at the high rates prevalent in some localities; in short, because the money market is being exploited by bankers and capitalists for their individual benefit.

The adoption of the new banking system, at this time, and the general improvement in conditions, now increasingly apparent, will shortly cure this rather unimportant difficulty. The market for municipal bonds is now the most active of any in long-time securities, because the security behind them is not in the least impaired by the troubles in the business world, and the cities can raise millions where railroads and other corporations can raise thousands.

During the few months which it promises to take to restore normal conditions, it is therefore good business for those supplying suitable machinery and materials to cultivate the municipal field. Even at less than the usual prices it will pay to get this business, for it will tide over until general business improves.

The municipal contractor who must take his pay in improvement bonds may have a little difficulty for a short time in disposing of his bonds and so he may be obliged to restrict his bidding to those places which pay cash. The situation can be eased if the cities which are authorized to do so will issue short time notes, later to be taken up by the issue of long-time bonds. But in any event it will not last long. From this date conditions have changed and the capital now waiting will find its most attractive investments in municipal securities, and this is likely to be the condition for a good many months. It behooves the contractor and manufacturer and dealer in contractors' and municipal machinery and supplies to pay special attention at this time to development of their business in this field.

The *Wall Street Journal*, the *Literary Digest, Engineering and Contracting, The Engineer Contractor, The Nation's Business, The Bond Buyer, The Annalist*, are a few of the more prominent periodicals which have also

made investigations in various lines and report results and opinions similar to those outlined above, making favorable reports regarding the practically undiminished activity in the municipal field, and the probability of material increase in that activity in considerable portions of the field.

STANDARD SPECIFICATIONS

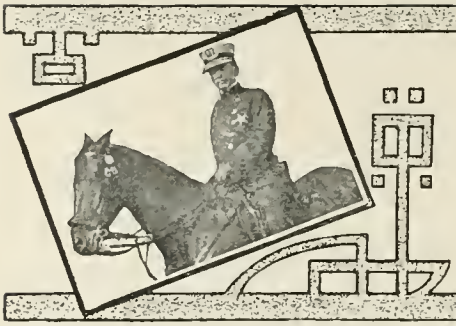
Editorials in the *Engineering Record* criticize the American Society of Municipal Improvements, no longer a small society, for doing the same things for which it approves the American Society for Testing Materials, and, doubtless from lack of information, fail to recognize the open program of discussion of proposed specifications and changes therein, heretofore in use in the former society.

The sub-committees are instructed to prepare specifications and proposed modifications of those previously adopted, with all the aid from all sources that they may desire. These specifications or changes are discussed at meetings beginning the day before the annual convention with the general committee on standard specifications, which is expected to open the discussion to every one interested in them, and has done so. Naturally the talking is done before the committees and but little is left to come before the association, tho there is again an opportunity for full consideration.

Actually, no full specification has ever been adopted by the association without at least one year's discussion and publication in the proceedings of the association, and usually two or three years have been required. It is difficult to see how any procedure could be more open or more carefully safeguarded from undue influences, including the one singled out for attack. This year more changes were up for action than usual, because of the reconciliation of differences between the specifications heretofore adopted by the A. S. M. I. and those of the A. S. P. S., and in two cases these were held up for another year's discussion. But one full new set of specifications was adopted.

The chairman of the general committee on standard specifications and the president of the society evidently agree with the *Record* in one of its positions regarding the principle of action of the American Society for Testing Materials, since they appointed chairmen and members of sub-committees according to that principle as far as the constitution of the society permits, only active members being eligible as working members of committees, aside from some representatives of the A. S. P. S. as provided in the terms of amalgamation.

Motives rather than results have been attacked, no specific charges regarding the latter having been made, and recommendation is made to the *Record* that it make a full investigation, in which case its general reputation for fairness will insure a material amendment of its inconsistent, insufficiently considered criticisms.



QUESTION DEPARTMENT

Makers of Weed Killers

Can you give me tidings of the Atlas Preservative Company of America? Wishing to try some "Weed Killers," I wrote that company, 97 Liberty street, New York, for sample of their Atlas "A" recommended in MUNICIPAL ENGINEERING a couple of years ago, but received no reply. Do you know who manufactures the stuff?

A., ———, Ont.

Can our readers refer our correspondent to the information he wants? Hendricks' Directory gives 95 Liberty as the present address of the Atlas Preservative Company of America, and also lists Horticultural Chemical Company, Bullit building, Philadelphia, Pa., as makers of chemical weed killers.

Books of Municipal Statistics Wanted

Will you kindly furnish us with directory of towns in states of Virginia and Florida, giving statistical data of municipality, population, bonded indebtedness and class of improvements, waterworks, electric lights, sewers and paving, etc.

If you do not furnish these books, please give us the names of people who do.

W., Atlanta, Ga.

Can our readers refer our correspondent to any publication or publications giving all the information he desires?

The U. S. Bureau of the Census publishes data on most of these points for cities of 30,000 population or more, but the writer is not acquainted with any publication which will give them for smaller cities and towns.

Pneumatic Street Cleaning Machines

I would like to know if you know of any pneumatic street cleaning machine. If so, who is it made by and has same proven satisfactory. H., St. Louis, Mo.

The Furnas machine is the only strictly pneumatic machine. The company has a new automobile machine, section of which is shown on p. 181 of the September number of MUNICIPAL ENGINEERING. It is made in Indianapolis, Ind. The Kern street sweeper, made in Sandusky, O., is a new candidate for popular favor. One of these machines is illustrated on the same page and others on p. 108 of the August number, where they are described. This machine has a revolving broom, which throws the street dust into an air current, which drops it in a dirt box, thus using the pneumatic process for removing the dirt swept up by the broom.

A machine on principles somewhat similar is illustrated in vol. xlvi, p. 527, and described in vol. xlv, p. 167.

An Italian so-called vacuum street cleaner is described in vol. xlvi, p. 160, which depends upon the suction produced by the rapid motion of the brush to aid in carrying the dirt swept up into the dirt box on the rear of the machine.

Society of Road Standardization

What is the "Society of Road Standardization of America?" Where is its headquarters and who are its officers" I have just read a newspaper clipping which says that two gentlemen reached Chicago for an initial trip to cover routes running thru seven states.

T., ———, O.

Can any of our readers give us information about this society, if such an association is in existence?

Rates for Sewerage Service

Will you kindly let me know where I can obtain information with regard to rates for sewerage service, whether charged by private sewer companies or by municipalities?

B., ———, N. J.

In MUNICIPAL ENGINEERING, vol. xxxix, p. 40, will be found a list of private sewer systems, with the rates charged by a number of them, and references to a number of earlier articles on the subject. In vol. xlii, p. 328, is a statement of the plan proposed at Vincennes, Ind., for renting sewers of a private company building them, and in vol. xliii, p. 119, is one on Ellsworth, Kans., neither of them giving the rates charged.

There are various methods of making

assessments to pay for the construction of sewers, but very few cities make a continuing charge for the use of public sewers. In addition to assessments of cost, several cities make a charge for connecting with the sewer:

Boston does not assess vacant lots when a sewer is built, but collects a fee of 2 cents a square foot up to 100 feet depth of lot drained when the connection is made.

Richmond, Va., makes an annual assessment of 10 cents a front foot on the abutting property, which may be commuted by paying $1.50 a front foot.

Brockton, Mass., makes a quarterly charge for sewer maintenance of 15 cents per 100 cubic feet of water entering the sewer from private properties.

Taunton, Mass., raises two-thirds the cost of operating and maintaining sewers by sewer rentals or charges and one-third by general taxation.

These cities are all of more than 30,000 population, and data concerning them may be found in Special Report of the Bureau of the Census giving General Statistics of Cities of over 30,000 population for 1909.

Atlantic City is at present the only city of more than 30,000 population whose sewer system is owned by a private corporation.

The various kinds of charges made for sewer service are not well shown in the report above referred to, but the following figures taken from it may be of interest. Receipts from permits for making sewer connections were reported from fifty-eight cities, amounting to $310,632. One city reported receipts of $87,383 for making sewer connections, derived from special assessments, and one reported $81 received for making sewer and water connections. Three cities reported total receipts of $11,995 for privileges of constructing and maintaining private sewers.

The receipts in 1912 of Richmond, Va., on account of fees and charges on the sewer system were $18,261. Those of Brockton, Mass., were $56,845. Those of Taunton, Mass., were $10,576. Those of Boston, Mass., were $23,445.

The only other cities having receipts as large as Taunton are Chicago, Ill., $23,606; Cleveland, O., $17,966; Buffalo, N. Y., $16,082; Newark, N. J., $20,061; Springfield, Mass., $29,532; Galveston, Tex., $22,416.

Several Texas cities have established more or less extended sewer systems by use of private capital, some of which have passed over to public ownership. None of these are contained in the report, as none of them have over 30,000 population. The receipts by Galveston, above reported, indicate that that city makes special collections of some sort for sewer service. Fort Worth received $2,907 and Houston $150 on the same account in 1912. If any of our readers can give information about sewer systems constructed with private capital, and methods of paying for the service in Texas towns or elsewhere, they are requested to give it, as data are difficult to obtain on this subject.

The city of Vincennes, Ind., is recently reported to have chosen the option under the franchise for construction of its sewers by private company, of paying an annual rental which will retire the bonds of the system in twenty-five years, when the system will pass to the ownership of the city. If the city fails to pay the rental, then the company can collect rentals at franchise rates from the citizens using the sewers.

Smoke Consumers

I would like to have full particulars on smoke consumers. Can you give me details concerning efficiency, price, etc.

L. B., ———, Que.

The ter m"smoke consumer" is not now in the best repute, the consumption of smoke after it has been formed not being an economical solution of the smoke problem, and seldom being practicable. Prevention of smoke is the line on which engineers are now working and there are many designs of smokeless furnaces, fuel economizers, and the like, not to mention the simplest methods of feeding a furnace according to its design without over or underloading, locating boiler properly with reference to the fire, making a proper design for the fire box for the work required, the principal objects being to run the furnace regularly and not to overload it, and to feed the fire in such way as to produce no unnecessary smoke.

Among makers of various types of apparatus intended to aid in attaining these objects, including mechanical stokers, are the following, and there are many others, of all grades of cost, efficiency and reliability:

Aeolipyle Co., Chicago, Ill.

American Stoker Co., Erie, Pa.

Babcock & Wilson Co., New York City.

C. O. Bartlett & Snow Co., Cleveland, O.

Casey-Hedges Co., Chattanooga, Tenn.

Erie Foundry Co., Erie, Pa.

Fuel Economizer Engineering Co., Philadelphia, Pa.

Green Engineering Co., Chicago, Ill.

Green Fuel Economizer Co., Matteawan, N. Y.

B. F. Sturtevant Co., Hyde Park, Boston, Mass.

Harrisburg Foundry & Machine Works, Harrisburg, Pa.

Hawley Down Draft Furnace Co., Easton, Pa.

Model Stoker Co., Dayton, O.

Parsons Engineering Co., Wilmington, Del.

Power Specialty Co., 111 Broadway, New York City.

Standard Stoker Co., Wilmington, Del.

Geo. H. Thacher & Co., Albany, N. Y.

Underfeed Stoker Co. of America, Chicago, Ill.

Westinghouse Machine Co., E. Pittsburg, Pa.

Ordinance Regulating Moving Picture Shows

Is it not a fact that most cities have an ordinance prohibiting the conducting of moving picture shows on the second floor of any building? And to what extent do the regulations of cities make the housing of the picture machine fireproof from a fire originating from within same?

H., ———, Ariz.

City regulation of moving picture exhibitions is becoming more strict as the necessities of careful regulation become more evident. The provisions of the ordinance given in the July number of MUNICIPAL ENGINEERING, vol. xlvii, p. 35, seem to be an example, and are none too strict. Sec. 352d., Clause 2, limits location to the ground floor and Clause 7 requires fireproof booths for the moving picture apparatus.

Section 352j provides for the occasional exhibition of moving pictures for educational or religious purposes without charge for admission and for the annulling of the provisions covering moving picture shows proper, except as to the fireproof booth, the licensing authority being given the power and duty to inspect and to determine the restrictions that shall apply, according to the circumstances of the case. Every case of proper exception to the rule seems to be covered by this section and it really errs on the side of leniency, such occasional exhibitions being quite as dangerous while they last as the regular exhibitions, if the conditions of the building are not such that it is fireproof and the exits are ample for the crowds in case of accident.

Who Designs Park Fountains?

In response to the inquiry in the October number of MUNICIPAL ENGINEERING, regarding designers of park fountains, the following information has been received:

Whitehouse and Price, Hutton building, Spokane, Wash., have designed several fountains and other park and garden accessories.

Irving J. Gill was the designer of the electric fountain in the small park opposite the U. S. Grant Hotel, San Diego, Cal.

Lilla P. Taylor, Cottage Grove, Ore., sends a photograph of a small concrete fountain of her design.

Nancy Coonsman, 6191 Delmar boulevard, St. Louis, Mo., won first prize in an open competition for all architects and sculptors in Missouri for the design of a fountain to be built in the sunken gardens in Library park, St. Louis.

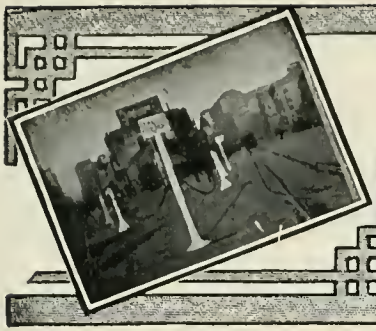
Nitrates May Be Produced in United States

The European situation has called attention sharply to the dependence of this country upon Germany for its potash supply, some 12 or more million dollars' worth of which is used annually in the United States for fertilizer. Another necessary mineral fertilizer for which the United States is entirely dependent upon a foreign country is sodium nitrate, over 21 million dollars' worth of which was imported from Chile last year.

Deposits of sodium and potassium nitrate are known in Utah, Nevada, California, Oregon, Montana and New Mexico, and have been described in publications of the Geological Survey and Bureau of Soils, but thus far no material of this kind has been found in sufficient quantity to promise commercial value. The latest report that has come to the Geological Survey relates to a deposit in Arizona.

One important domestic source of combined nitrogen is the gas works and by-product coke ovens, which in 1912 reported a recovery of ammoniacal liquor, ammonia and ammonium sulphate valued at $9,519,268. This output of by-product ammonium sulphate increased in 10 years from 17,643,507 pounds to 99,070,777 pounds, and as it is linked with the great coking industry further increases can be expected.

Another domestic supply of nitrogen compounds lies in the fixation of atmospheric nitrogen by electricity. Cheap hydroelectric development is necessary to establish this industry, which would make our large agricultural and industrial interests free from the uncertainties of the foreign supply. It is hoped that the water-power legislation now before the United States Senate may promote hydro-electric development in large units and thus utilize some of the great water powers in the West in obtaining nitrogen from the air.



WORKERS IN THE FIELD

Waterproofing Paint for Cement Block Houses

To the list of manufacturers of waterproofing paint for cement block houses, given in the July number of MUNICIPAL ENGINEERING, vol. xlvii, p. 33, should be added the Barrett Manufacturing Company, 17 Battery Place, New York City, who supply a high grade of water-proofing paint.

Trigonometric Tables of Grads

The Editor of MUNICIPAL ENGINEERING:

The question of "L—, Conn." in reference to a table of grads or centesimal divisions of the quadrant, on page 215 of your September issue, has just been brought to my attention.

I have such a table in my possession which may be the book referred to by you in the note following the question, the title being as follows:

"Tables portatives de logarithmes, contenant les logarithmes des nombres depuis 1 jusqua 108,000, les logarithmes des sinus et tangentes de seconde en seconde pour les cinq premier degres, de dix en dix secondes pour tous les degres du quart du cercle; et, suivant la nouvelle division centesimale de dixmillieme en dixmillieme," etc., etc. Par Francois Callet. Edition stereotype. Paris Firmin Didot, Imprimeur du Roi, de l'Institut, et de la marine, etc. 1795 (Tirage 1857).

Besides the more common tables (seven place) of numbers, sines, cosines and tangents, this book contains seven place tables of sines, cosines and tangents in the centesimal division of the quadrant; 20 place tables of common and hyperbolic logs. from 1 to 1200; 20 place tables of logs. with first, second and third differences for numbers from 101,000 to 101,180, and for numbers for logs. from .00000 to .00180; natural sines and cosines and their logs. to 15 places centesimal division; common logs. to 61 places and hyperbolic logs. to 48 places for numbers from 1 to 100, prime numbers from 100 to 1,097, and numbers from 999,980 to 1,000,021; ratios of lengths of degrees to radius taken as unity to 25 places for common and centesimal divisions of quadrant; and other curious and rare tables.

ELLIS B. NOYES,
Portsmouth, Va.

Motor Trucks for Market Delivery

Motor trucks are strongly recommended as a means of preventing the increasing cost of living in Chicago in a preliminary report issued by the Chicago Municipal Markets Commission, appointed by Mayor Harrison.

After showing that the city consumer pays an average of $1.90 for produce that the farmer sells for $1.00, the commission states that it costs more to haul 100 pounds of potatoes, fruit or other farm products five miles from the docks to the city consumer or the retail store than to ship them by boat from Michigan to Chicago, and it costs nearly half as much (50 cents) to deliver a ton of coal from the railroad tracks to the consumer in the business district of the city as it costs to ship the coal 400 miles by rail ($1.05) from southern Illinois to Chicago.

It is estimated that in an area of less than two square miles in the heart of the city 150,000 tons of freight are hauled daily. About 1,000 teams are engaged in hauling food products, exclusive of the delivery service of the retailers, and, to make a profit for their owners, single teams must earn about $6 a day and double teams $8.

"Team hauling is decidedly antiquated, wasteful and inadequate," observes the report. "Because of the congestion existing in the streets of the central business district and the consequent inadequacy of the streets to afford free passage to vehicles, the average wagon or truck spends about one-third of its time actively hauling commodities and two-thirds in waiting, loading, unloading and in delays to traffic.

"Animal transportation is out of place and an archaic survival. Under present methods of hauling, food products are invariably exposed for hours to the heat of the sun. The motor truck as a carrier of food products assures to the consumer better food, lower prices, and a lower cost of hauling. Detailed comparisons showing the cost of hauling by horses and wagons and motor vehicles indicate that the average cost of hauling in the city by motor is 11¼ cents per ton mile as compared with 17¾ cents by horse.

"The average cost of deliveries by department stores, grocery stores and meat markets is shown to be approximately 8 cents by motor and 16 cents by horse."

Automatic Bell Warning at Garage Exit

An interesting bit of "Safety First" work has been put in practice by the proprietor of a garage in Louisville, Kentucky, whose example might well be followed in other places.

Motor vehicles leaving this garage are obliged to cross the sidewalk of a busy street along which pedestrians are passing all hours of the day and night, and as a warning a lamp has been installed in front of the exit in a large globe, on each side of which the word "Danger" is painted in large letters.

This lamp is lighted from sunset to sunrise and in itself forms an effective cautionary signal. It is, however, supplemented by a loud-ringing gong, which is automatically operated whenever a vehicle approaches the exit door, a steel plate being so placed that it automatically closes the contact with a copper spring and rings the bell whenever the wheels pass over it.

Our correspondent writes that it is interesting to note how pedestrians passing along the sidewalk intuitively "stop, look and listen" at the instant the bell begins to ring and wait until the automobile has crossed the sidewalk into the street. It has been suggested that local authorities would do well to enforce the installation of such a device at the entrance to every garage located on busy thorofares.

Improvements in El Paso, Tex.

El Paso, Tex., is growing so rapidly that it is difficult for the construction and engineering departments to keep up with the demands for water pipes, sewers, sidewalks and garbage disposal. The city is building about a half mile of cement sidewalks a month. A two-mile trunk sewer, 36 to 48 inches in diameter, was recently completed in reinforced concrete. The street paving is of different grades of bitulithic. A half mile on North Kansas street is about finished. A reinforced concrete bridge is under construction. George Espy is city engineer and F. H. Todd is consulting engineer. S. H. McMullen is a member of the engineering force.

Electric Light Service for Freeport Texas

Freeport, Tex., has a new electric lighting and power system suitable to meet the needs of this growing seaport. In connection with the new superheated water and power plant installed at the Freeport Sulphur Company's mines at Bryan Heights, a new central electric power plant was included in the plans. This plant, thru transmission lines, will supply electric light and power to Freeport, taking the place of a much smaller plant.

This plant includes a 200-k.w. Westinghouse steam turbine direct connected generator set.

This central power station will do all the work at the mines at Bryan Heights, in operating electric driven pumps to pump water from the canal and fuel oil from the storage tanks on the Freeport ship channel to the mines, providing power for the machine shop and for commercial and domestic lighting and power at Freeport.

Fans For Fighting Fire

We have all heard of fighting fire with fire, but the use of electric fans as an adjunct by a fire department in putting out a blaze is surely novel.

In Boston not long ago, a fire broke out in the basement of a building occupied by a wholesale paint and chemical concern. The fumes and smoke became so thick it was impossible for the firemen to enter the basement or direct a stream with any effectiveness, when someone thought of electric fans. A half dozen of the ordinary 16-inch size were quickly requisitioned by the fire chief and their breeze was directed down the stairway. As soon as the rear basement windows were broken to allow the escape of the smoke and fumes, the effect of the fans gradually cleared the basement so that the firemen could work quickly and effectively in extinguishing the flames.

ROADS AND PAVEMENTS

Repairs to Concrete Pavements

The following brief description of the methods of repairing the concrete pavements in Wayne county, about Detroit, Mich., was written by Frank F. Rogers, the state Highway Engineer of Michigan, and may be taken as authoritative:

Repairs to the Wayne county concrete roadways have mostly been confined to expansion joints, where the edges of the concrete have chipped off, and to the defects above described, which are subject to the same action.

In making repairs, the cracks, whether at expansion joints or other places, are broomed out clean, preferably when the weather is warm and dry, and poured full of hot refined tar. A portable heating kettle is moved along on the pavement and the tar is poured from long nozzled cans, which are fitted with long wooden handles. When filling a joint, the workman backs up, dragging the nozzle of the can along the crack, which is filled about as rapidly as a man can work. As fast as the joints are filled, another laborer follows up and spreads a layer of dry, sharp sand over the tar to a depth of from ¼ to ½-inch. Pit holes, unless large, are filled with tar and sand in the same manner. It might be added that the tars are found to adhere to concrete better than the asphalts.

Repairs of this kind cost about $50 a mile, and have to be repeated each year. They prevent further deterioration of the pavement, both at the transverse joints and at the cracks which nature has formed. In fact, so far, the cracks do not seem to menace the life of the pavements.

In a few places where holes have formed, due to defective mixing or to some foreign substance accidentally getting into the concrete, repairs have been made by chiseling out the concrete down to the subgrade, brooming off the sides, and filling the excavation with concrete of the same kind as used in the original construction. The cost of this kind of repair has been a negligible quantity, as compared with the others.

The transverse joints on the early construction were formed by placing three strips of tar paper between the 25-foot sections. Later, sheared steel plates, separated by strips of tar paper, and having prongs which are bedded in the concrete of the adjoining sections, have been used. So far, there has been little or no chipping of the edges of the concrete next to the steel plates. However, the joints are all kept filled and covered with tar and sand to prevent possible wear.

On two roads, which were completed late in the fall, short sections of the surface become thickly pitted to the depth of ¼ to ½-inch, due to opening the road to traffic before the concrete was thoroly hard. These defects have also been repaired by covering with sand, as in the case of the joints and cracks. This coating has to be renewed when it wears away.

A few sections of the Michigan avenue road, not in need of repair, were tarred and sanded in 1911, to watch results. Only a small part of this was worn off during the first year, but so far, the kind of repairs I have endeavored to describe are all that the Wayne County Road Commissioners have found necessary or advisable.

Paving with Small Granite Blocks

The recent articles in MUNICIPAL ENGINEERING on recut granite blocks in Schenectady, N. Y., and the papers on similar block pavements in the Boro of The Bronx, New York City and in Newark, N. J., before the American Society of Municipal Improvements, one of which will be found elsewhere in this number, are evidence of the present interest in paving with small granite blocks.

The first pavement of this sort in the United States, of which the writer is informed, was laid in Troy, N. Y., in 1907. The next were laid in the Boro of The Bronx in 1909, as described in Mr. Thompson's paper, above referred to. The pavements in Schenectady and in Newark were laid in 1913. Small areas of ragged old granite block paving have been laid in sev-

eral cities such as Philadelphia, Brooklyn, Manhattan, Trenton, N. J., Kearney, N. J., all being quite new, but they are unimportant in amount and most of them not very definite as to specifications for blocks, the old material on hand having been used, napped, chipped or otherwise dressed as seemed simplest, easiest and cheapest.

One form of small granite block paving has been in use in European countries for some thirty years. It is known as Durax in England, and as Kleinpflaster in Germany. A small amount of this paving was laid in 1913 in the U. S. Navy Yard at Brooklyn, N. Y., and some has been laid this year at Salisbury, N. C.

The experience with this paving is reported to be very satisfactory in foreign countries, where it has been in successful use for so many years that its life is confidently stated to be 25 to 30 years, so that a brief description of its characteristics will be of interest. The accompanying photographs give some idea of its appearance and show its most prominent characteristics.

Like every good pavement, Durax should have a good foundation, preferably concrete, proportional to the weight of loads and amount of traffic, tho some excellent automobile and comparatively light traffic roads and streets have been laid on the old macadam as a base.

The blocks, as shown in the photographs, are small, and of rather irregularly cubical forms, specifications calling for dimensions between 2¾ and 3½ inches being usual. The sides may taper slightly so that the bases are smaller than the wearing surfaces. Before laying they are sorted to give uniform depths of blocks, the shallowest blocks being used next the curb or outer edges of the road.

The patterns in which the blocks are laid are chosen with the purpose of having no joints lying at right angles to the lines of moving vehicles and so that no two wheels of a vehicle will cross the same joint or course of stone at the same time. This conduces to better foothold for horses and more uniform wear under wheels so as to promote the continuance of a smooth surface.

It is usual to bed the blocks in a cushion of sand or fine stone chips and to use a cement grout filler, thus preventing such defects in design, construction and wear as tilting, riding, formation of waves, disintegration, creeping, crumbling, softening or raveling. Bituminous fillers are also used successfully.

The cost of the pavement is not yet defi-

DURAX PAVEMENT *laid in Munich, Bavaria. Note interweaving of the circular arc patterns in which the blocks are laid. Form and small size of blocks are well shown also.*

DURAX PAVEMENT *on Avenida Alocar Esquina Gallo. Buenos Aires. Argentina, South America.*

nitely known for all conditions. When the Brooklyn Navy Yard pavement was laid, bids were received for 4-inch granite blocks under a very rigid specification as to sizes, for Durax, and for the usual oblong granite paving blocks. The 4-inch blocks laid on existing foundation were bid at $4.98 a square yard, including ½-inch cushion and filler of the same material filled flush with coal tar pitch. The bid on Durax was $3.25 and the bids on the standard oblong block were from $3.28 to $4.68, the former, on the New York City specification being 12 cents less than the bid by the same contractor on the Navy Yard specification. Bids for wood block pavement, received at the same time, were from $2.37 to $3.20.

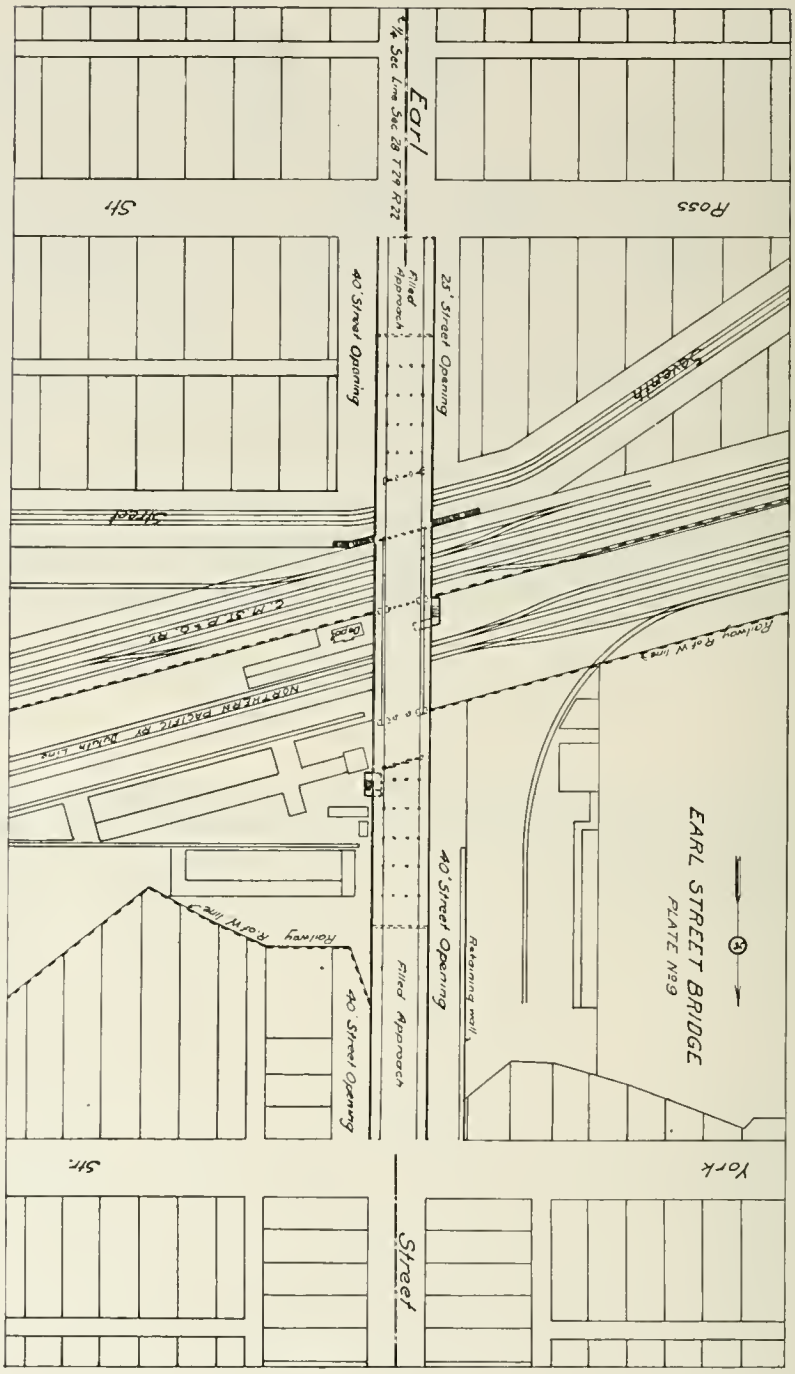
The cost of paving done in Schenectady, including cost of breaking and dressing old blocks, but not including the cost of the original blocks, was $1.52 a square yard. The cost of taking up the old pavement and of taking up the old granite blocks used in the new pavement, was 16 cents a square yard, and the new concrete foundation cost 33 cents a square yard, making the total cost on a typical street, $2.01 a square yard. To the cost of $1.52 a square yard given above must be added the cost of the granite blocks and some part of the cost of cutting them, in order to make the figures comparable with those of the Brooklyn job. It is probable, also, that the hand breaking and dressing in Schenectady was more expensive than the machine cutting of blocks used for the Brooklyn job, a special machine having been devised for cutting granite blocks for Durax paving, at a minimum of cost and of waste of material.

There are no patents on the pavement itself, which is laid thus far in this country by the Wern Stone Paving Co., of New York.

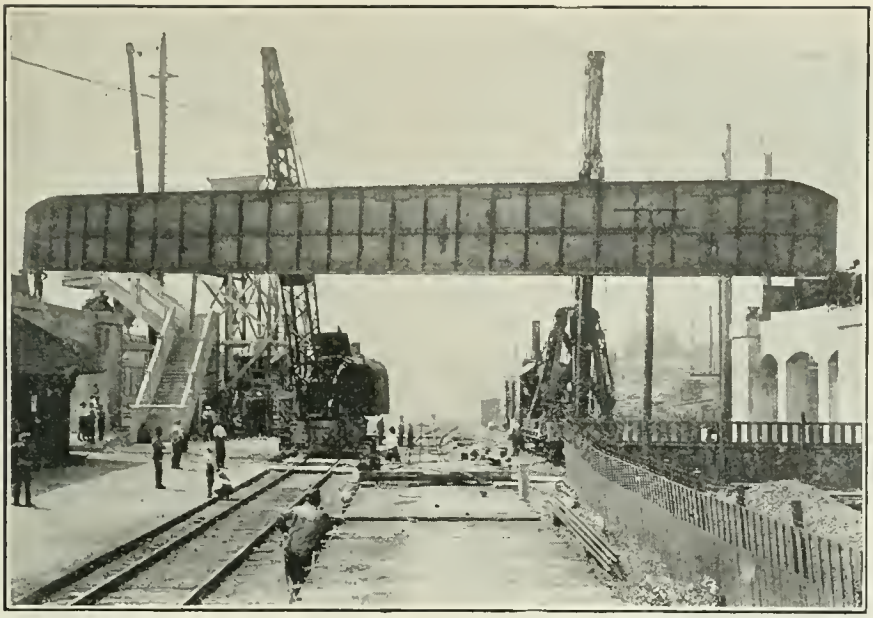
Cost of Supervision of Highway Construction

The following statement shows the annual cost of supervision of construction of highways by the state highway department of Ohio in percentage of the amounts expended by the state in such construction:

1914	4.03%
1912 and 1913	5.71%
1911 and 1912	6.18%
1910 and 1911	6.40%
1909 and 1910	5.39%
1908 and 1909	5.43%
1907 and 1908	5.28%
1906 and 1907	7.55%



Grade Crossing Elimination, Seventh and Earl Streets.



LIFTING A 115-FOOT GIRDER *into its place in the Earl street viaduct.*

The amount of public money expended on highway construction in 1914 has been $6,600,000, of which $3,150,000 came from the state treasury and $3,450,000 from the counties.

The Earl Street Bridge, St. Paul, Minn.

The Earl street bridge in St. Paul, Minn., is a viaduct carrying Earl street over the tracks of the C., M., St. P. & O. and the N. P. railroads and the street railway tracks on Seventh street. The accompanying plan and photograph show clearly the lay-out of the structure. The south approach begins at the north line of Ross street and the north approach at the south line of York street, the total length being 932 feet. The south approach walls are 97 feet long, north approach 211 feet. The southern reinforced concrete trestle is 350 feet long and the northern 180 feet, connecting the filled approaches with the steel spans, which are respectively 65 feet over Seventh street, 73 feet over the C., M., St. P. & O. railroad, 114 feet over the N. P. railroad and 43 feet over a roadway on the north side of the railroad right-of-way. All of the bottom steel in the girders over the railroad tracks is incased in concrete for protection, 590 cubic yards being used for this purpose, with 65,209 pounds of reinforcing steel to hold it in place.

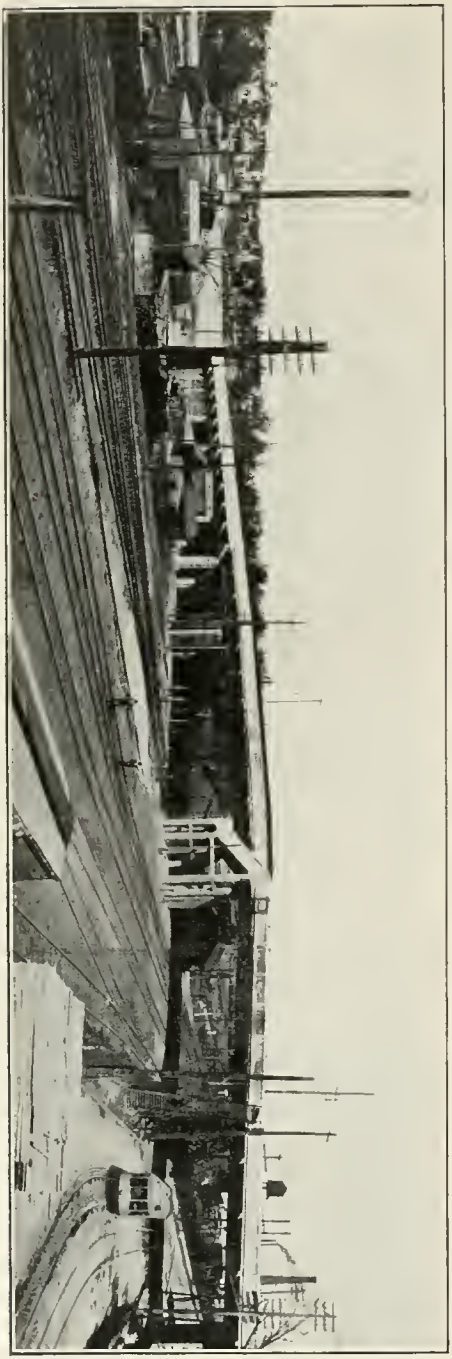
The materials used include the following additional amounts: Concrete in approaching retaining walls, 1,617 cubic yards. Concrete in reinforced concrete trestle, 1,922 cubic yards. Reinforcing steel in retaining walls and trestle, 385,888 pounds. Structural steel in girders, 445 tons. Concrete railing, 575 linear feet.

The viaduct has a 40-foot roadway paved with creosoted wood blocks on the more level portions and with sandstone block on the inclines.

The concrete sidewalks are 8 feet wide. There are two concrete stairways and two steel stairways, one of the former and both of the latter seen in the photographs. The total cost of the structure was $117,000.

The smaller photograph shows the process of placing one of the 115-foot girders. It was brought to the location on flat cars, one of which is seen in the foreground. The two locomotive cranes in the rear picked it up, swung it thru a turn of 90 degrees or so, and are now dropping it on its seats on the piers at either side.

We are indebted to J. E. Carroll, assistant city engineer, and Geo. H. Herrold, office engineer under Oscar Claussen, chief engineer, for the photographs and data given.



VIEW OF EARL STREET VIADUCT
from the west.

Prison Labor on West Virginia Roads

Success in convict road work is reported from West Virginia. This road work has been developed as the result of legislation passed at the last session of the legislature. Prior to this session Governor Hatfield and representatives of the legislature and supreme court jonrneyed to New York for conference with the national committee on prisons and prison labor.

At the conference, in which representatives of the department of highway engineering and the bill drafting bureau of Columbia University participated, a state road bnrean was planned to co-operate with the state prison department in working the prisoners upon the public roads.

A recent report received by the national committee on prisons and prison labor from A. D. Williams, chaiarman of the road bureau, states that to date three convict road camps have been established, the men being under the honor system and living in tents. Two of the camps are located on a stream and the men each evening go bathing and enjoy all the liberties of camp life. Three Italians have attempted escape, but the Americans and negroes are proving themselves worthy of trust.

At St. Mary's camp, in solid and loose rock the men have averaged 4.03 cubic yards per day. At the Inwood camp the average was 4.33 cubic yards, which included the erection of one concrete culvert 20 by 30 feet, 27 feet long, and sixteen days' labor for one man out of 118 laying tiling.

A crew of citizen labor was also working at St. Mary's camp on the same work, and an interesting comparison of costs was made. The cost of moving material by citizens was 83 cents per cubic yard, against 30 cents with the prisoners.

These developments indicate that thru road work West Virginia will to a great extent solve her prison problem.

The Filler for Brick Pavements

By G. L. Schomburg.

A problem that is given too little consideration in the construction of brick pavement is the matter of the filler. It would seem, from a number of instances coming under the writer's observation, that the matter of a filler was almost taken for granted, and that "anything will do." Nevertheless, this is a matter that should be given the greatest consideration, for the very success of this type of pavement depends on the filler used.

Brick itself is tough enough but their very nature demands a supporting agent

or an element that will enable them to demonstrate their true worth. If the brick themselves were just laid on the prepared base and nothing further done it would only be a short time until they would be displaced by traffic. It, therefore, becomes necessary to place something between and around the brick to hold them in place. It is necessary that this agent perform other functions in order that it serve its purpose fully. The movements of the pavement caused by contraction and expansion must also be overcome, and further than this the penetration of water and street liquids must be guarded against.

Asphalt filler was first produced in 1898 and its use has increased year after year, until now it is accepted as a standard material for filling the interstices of a brick pavement.

In drawing a set of specifications it is not sufficient to state "The interstices of the brick and all openings around manholes and along the gutter shall be filled flush with an asphalt filler" and stop there. The right start has been made toward the correct filler, but in order to secure an asphalt that will perform the necessary function of a brick filler it is necessary to go further with the chemical and physical requirements of the filler to be used.

The readers of this article who have to do with the drawing of specifications, will agree with the writer that the essential feature of a specification is the limitation placed upon the contractor obliging him to use material of a character which will make a thoroly satisfactory piece of work. The specification is in no proper sense an effort to eliminate competition, but is simply a means of requiring the contractor to supply material of certain tested value as to its fitness for the work.

The following specification for asphalt filler is one that is entirely open, in that it can be met by several of the asphalt fillers now on the market and therefore will admit of competition, and if the material complies in all respects the city or user will be assured of securing an ideal asphalt filler.

The interstices, or joints, of the brick (or block) shall be completely filled with an asphalt filler, which must conform to the following standard of quality:

(1) It shall contain not less than 98 per cent. pure bitumen soluble in carbon disulphide (CS_2).

(2) Of the total amount soluble in carbon disulphide (CS_2) 98½ per cent. shall be soluble in carbon tetrachloride ($C Cl_4$).

(3) When tested with a No. 2 needle weighted with 200 grams operating for one minute at 32 degrees Fahrenheit, it shall have a penetration greater than 25 (Dow method).

(4) When tested with a No. 2 needle weighted with 50 grams operating for five seconds at 115 degrees Fahrenheit, it shall have a penetration not greater than 80.

(5) When tested with a No. 2 needle weighted with 100 grams and operating for five seconds at 77 degrees Fahrenheit, it shall have a penetration between the limits of 35 and 50.

(6) Its specific gravity at 60 degrees Fahrenheit shall be greater than 0.975 and less than unity.

(7) It shall have a melting point not lower than 225 and not greater than 285 degrees Fahrenheit.

The filler shall weight not less than 8 nor more than 8½ pounds per gallon at 60 degrees Fahrenheit.

It shall remain ductile at climatic temperatures to which it shall be subjected, shall be waterproof, acid proof and impervious to street liquids. Shall adhere firmly to the brick (or block) and be pliable rather than rigid, thus providing for expansion, contraction and traffic conditions.

The filler must be heated sufficiently to allow proper pouring (about 400 degrees F.) taken from the kettles in buckets and poured from pouring cans.

The contractor must be equipped with pouring cans especially designed for this purpose.

All joints, at both sides and edges of the bricks (or blocks), must be filled completely by pouring the material directly into and flush with the top. The material as poured, shall be at a temperature of not less than 350 degrees F., nor more than 400 degrees F. As the work progresses and while the material is still hot, there shall be sprinkled over the entire surface a layer of clean, dry sand.

If an asphalt filler having the above characteristics is used it will result in a thoroly waterproof, practically dustless, noiseless and sanitary pavement. The asphalt filler will adhere firmly to the brick and will neither "run" in the summer sun or become brittle and chip in cold winter weather, also protecting the edges of the brick and take care of all contraction and expansion.

To sum it all up; a good asphalt filler will make a brick pavement noiseless, dustless, waterproof and sanitary. Another feature that should appeal to the people at large, is the fact, that the street can be thrown open to traffic immediately after pouring.

An article descriptive of a new type of brick pavement requiring the use of asphalt filler, will be published later.

Improvements in American Paving Practice Suggested by European Experience

A report by George W. Tillson, consulting engineer to the President of the Boro of Brooklyn, N. Y., made as a result of an examination of city streets and pavements in certain European cities, in 1913, has been published. It contains very interesting and profusely illustrated descriptions of pavements in many European cities and makes a number of suggestions for improvement of American pavements based on his observations, from which the following has been selected:

As it has been admitted that the best pavements of this country when laid are as good as those of Europe, and that practically the same materials are used, it might be pertinent to suggest methods of procedure in this country so that the condition of its streets would be improved, and the following are offered:

1. Standard first-class paving material only should be used and the proper material selected for each street.

This suggestion is generally carried out at the present time, except that it does not seem that sufficient care is given to the selection of the right material for any particular street.

2. Work should be done carefully, with special care for small details.

3. The funds for new pavements should be provided in advance, so that at least several months should intervene between the time when it was known what streets would be paved and the carrying out of the work, and an attempt should be made in each case to determine when the work was to be ordered and just when it should be carried out on each particular street.

If this were done corporations and individuals could make definite plans for repairs to any subsurface work that might exist in the streets, and also provide for new construction if any were necessary. It must be admitted, however, that in large cities, where a great amount of work is to be done and where it is necessary to let work to the lowest responsible bidder, it would be difficult to determine this in every case. It would, too, be more difficult in the case of new work than in repaving, as when new work is ordered the demand for its immediate completion is very strong. At the present time the Board of Estimate and Apportionment will not permit an original pavement to be laid unless water, sewer and gas mains have first been constructed, but other subsurface work is often necessary. It is believed, however, that if an earnest attempt were made to determine some time in advance just when work should be done, it could be more nearly accomplished than would seem probable at first thought. The advantages of it, however, are so great that even a partial success would be worth much more than it would cost.

4. The number of openings in the pavement should be reduced to a minimum.

It must be admitted that with the different kinds of subsurface work in the streets of this country, and nearly all being in the roadway, with the general changes that are taking place in the character of business along the streets, many openings in the pavements are necessary. This being the case, it becomes all the more important to reduce this number to a minimum. When mains are laid in the street, openings must he made for their repair, but if, previous to the construction of the pavement, corporations put all of their subsurface structures in good repair, there should not be the necessity to make openings for some time to come. Emergencies, however, will arise when openings must be made, and that condition must be accepted.

The street belongs to the city for its entire width, from property line to property line, and its entire width should be used to the best advantage and not the roadway only.

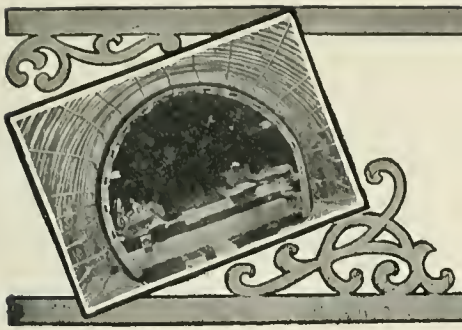
It must be admitted that it is a proper requirement in our crowded cities to have everything underground that it is possible to place there, but it does seem as if the telephone and electric light companies could work out a scheme by which possibly one connection could be made with the main in the street for each block and subsidiary connections made to this sub-main by property owners in the block without tearing up the roadway pavement.

5. The surface of the pavement should be broken by any foreign construction as little as possible.

Street car tracks are necessary, but they should be built in such a way as to conform as nearly as possible to the surface of the street and so that the pavement can be easily maintained adjacent to them. Manhole heads also tend to vary the surface of the pavement, and while, with the present construction of the underground system, they are necessary, they should be as few as possible and built with the utmost care. This fact is recognized abroad, where manhole heads are much less frequent on the streets than in this country, and in Paris almost none were seen on the streets. In Glasgow and Edinburgh structures to take the place of electrical manholes in the streets are erected on the sidewalk.

6. Repairs should be made promptly and in a first-class manner.

7. The city officials and those of the street car companies should work harmoniously, so that railroad work will be done properly and permanent repairs or necessary reconstruction made at the time the streets are paved.



SANITATION

Sewerage of Vancouver District

Operations have been proceeding without interruption since last December in connection with the first unit of sewerage construction undertaken by the Vancouver and District Joint Sewerage and Drainage Board as part of the immense joint sewer system embracing the entire area of Burrard Peninsula, which includes 55,600 acres, of which only about 10,000 acres are within the present boundaries of Vancouver, the remainder being in New Westminster, South Vancouver, Point Grey and Burnaby.

R. S. Lea, consulting engineer, of Montreal, was retained by a joint committee composed of representatives from each of the municipalities interested—with the exception of New Westminster, to advise them as to a general scheme for the whole peninsula and the best means of constructing and maintaining such a scheme in a state of efficiency. His report, which was submitted early in 1913 and adopted by the committee, advised the formation of a permanent sewerage board, this action being carried out forthwith and duly legalized by the provincial government, which at the same time granted financial assistance in the form of a government guarantee covering the interest on $10,000,000, the sum for which the board is empowered to issue bonds, and $5,000,000 of the principal.

Burrard Peninsula is divided naturally into five drainage areas, which discharge respectively into Burrard Inlet, False Creek, English Bay, Fraser River and Burnaby Lake. Each of these areas was studied as a separate problem in laying out the general scheme, except that the disposal of sewerage from each area was considered in the light of its relation to the other districts or the waters there available for distribution.

The principal discharge into Burrard Inlet will be thru an outfall, located at Clarke Drive, which is to drain an area of 8,250 acres, with an estimated population of 238,000 in 1950. Parts of the area being made tributary to the Clark Drive sewer will drain into False Creek and Burnaby Lake. The initial work now in progress and steadily approaching completion comprises a portion of the Canoe Creek and China Creek sewers, which the board decided to construct by day labor. The expenditure to August 1 was $181,000, distributed as follows: Labor, $114,000; material and stores and plant depreciation, $60,000; plant (present value), $7,000.

The work covers the construction of plain concrete sewers and tunnel and reinforced concrete sewers in open trenches. About 70 per cent. of the construction has been completed to date. Nine shafts of an average depth of 25 feet, and 8 by 8 feet across, were sunk at various points in the tunnel during the early stage of operations, and driving was then commenced in opposite directions from each shaft. Altogether, about 3,500 feet of tunneling has been undertaken in what is known as contract No. 1. About 1,000 feet of this is thru hardpan, most of the remainder being in soft ground, with a small section thru running sand. The cost of the miner's piecework amounted to $5.00 per foot thru rock, and $6.00 in soft ground, or $5.50 per foot on an average. The size of timbers used in the tunnel was 8 by 8 feet for the segment sets, with 2-inch lagging or poling boards. The proportion of concrete used was one part of cement, two of sand and four of ¾-inch gravel. The method of applying the concrete was first to line the lower half of the tunnel from shaft to shaft and then attend to the roof and upper portions, working from opposite directions towards a given center, a concrete mixer being placed at each shaft. No reinforcing was used in the tunnel. The sewers in trenches, however, besides being lined with concrete on the same principle as the tunnel, have been heavily reinforced with ½-inch twisted steel except where the ground in the bottom of the trench was sufficiently hard; in such cases no reinforcing was required in the lower half other than for bonding purposes.

An interesting feature of the excavation for the tunnel was the method of hoisting the dirt thru the shafts and dumping on the adjoining vacant lots by means of a self-dumping Alaska trolley. This trolley is really the outcome of mining in Alaska, where the cost and supply of labor have always been very material considerations. It is carried on a cable, suspended between the shaft and the dump. A chain attached to the rim of the bucket passes thru a loop, which, in turn, slides along a light wire running in a line underneath and parallel to the overhead cable. This loose rope extends down to the bottom of the tunnel shaft, where it is securely fastened during the operation of loading the bucket. As the bucket is filled and raised to the surface, the hoisting sheave comes into contact with a hammer attached to the trolley, thus releasing the trolley and enabling it to travel to the dump, where a trip, bolted on the loose ground wire at this point, abruptly arrests the progress of the suspended chain, the shock of the contact inverting the bucket.

Practically all of the plant used in connection with this work was purchased second-hand and therefore at comparatively low cost, an expenditure of less than $8,000 covering the total outlay under this heading. No difficulty has been encountered in obtaining a sufficient supply of labor since the commencement of operations. A force of about 250 men has been constantly employed, the municipal wage rate of $3.00 per day of eight hours being paid.

The cost system employed on the work was designed by Mr. L. E. Wilson, the resident engineer, and could be conveniently adapted to all classes of construction work. All plant purchased for the job was charged on a rental basis at a rate per day commensurate with the life of same, and at the completion of the work the difference between the shipping value plus the total rental charged, as compared with the original purchase price, would be a debit or credit balance, as the case might be, and apportioned to the section of the job properly chargeable with it. The stores were charged every month directly into each section of the job, wherever possible, and where items of general stores could not be so charged direct for the reason that they would be used more or less on the whole work, then the cost was distributed pro rata between the various sections of the work in the proportion that each section bore to the whole contract, and further subdivided pro rata between concrete and excavation in their respective ratios. All tools, such as picks, shovels, hammers, saws, etc., were treated as general stores, as it was considered these would all be worn out on the work, and any value they might possess at the close of operations could be easily adjusted in the final statement of the cost. Progress statements of the cost, together with plans, were turned in to the chief engineer every month. A stock account was kept of the materials used in concrete and was shown at the top of the monthly cost statement.

Early in the present summer the Vancouver and District Joint Sewerage and Drainage Board decided to proceed with the second unit of its vast scheme, embodied in the estimates under the heading of "immediate construction"—which covers work to be undertaken during the next five years, at a cost of $5,500.000—and tenders for the work, which is known as "contract No. 2," were called, the following being the list of bids submitted by the various firms competing: J. Gault & Co., $396,396.65; Leddingham & Cooper, $376,769.13; engineer's estimate (day labor), $365,000; Union Contracting Co., $348,546.24; engineer's estimate (contract), $348,316.90; Moore & Pethick, $340,100.45; Robt. McLean & Co., $333,646; H. P. Peterson, $332,772.80; Hodgson, King & McPhalen, $309,052.72.

The board awarded the contract to the lowest tenderers, Hodgson, King & McPhalen Bros., of Vancouver, who have made all arrangements for immediately starting active operations. The contract covers the construction of some 2,700 feet of 6-foot 6-inch by 6-foot 6-inch horseshoe section, tunnel sewer, and about 5,000 feet of reinforced concrete sewer trench with vitrified brick invert, ranging from 6 feet 6 inches in diameter to 2 feet 6 inches in diameter, together with about 15,000 feet of reinforced concrete pipe sewer ranging from 42 inches to 24 inches in diameter. The conditions of this contract call for the payment of the municipal wage rate of $3.00 per eight-hour day for all ordinary labor employed. It is estimated that operations in connection with this branch of the scheme, which takes in the Clark Drive outfall area, will require about twelve months to complete.

Further developments contemplated by the board, which have been provided for in the estimates, include the conservation of the natural drainage channels of the Burnaby Lake district, a work that is considered of paramount importance in its relation to the combined system of trunk sewers. Part of this project comprises the deepening and improving of the Brunette River, which is the overflow from Burnaby Lake. The lake itself is a shallow sheet of water with a mean water area of about 430 acres and a maximum depth in the center of 9 feet. It lies between Vancouver and New Westminster, at a point about nine miles east of Vancouver. Owing to the presence of a natural rock dyke which lies across the outlet

to the Brunette River and virtually acts as a dam, the lake overflows its banks and floods the low-lying lands in the vicinity during periods of excessive rainfall. The drainage area, estimated at about 26 square miles, resembles a huge, shallow basin with one side broken—the latter conforming to the end at which the dyke is located. The work to be undertaken will consist of the lowering of the level of this dyke to a depth which will permit of satisfactory draining under any circumstances, and the construction of two intercepters for sewage disposal in the district.—*The Contract Record.*

The Public Bath An Americanizer

The free public bath is cutting a larger and larger figure as a factor in civic improvement. St. Louis is boasting of the recent opening, in one of her parks, of the largest concrete swimming pool in the world. Cleveland bitingly retorts with a detailed description of Lake Erie, claimed by that vigorous Ohio town as its unique asset for bathing purposes. New York might point to the Atlantic Ocean, available for similar purposes and quite largely utilized at Coney Island and elsewhere. Albert Wilhelm, in an article contributed to Modern Sanitation, classes the bath with the school and the church as an aid in Americanizing our foreign population. He says:

"A study of the public baths in the great cities like Boston, New York, Baltimore, Philadelphia, Chicago, St. Paul—the centers of such large communities of foreigners—proves beyond question that water is doing a remarkable work along these lines, especially in connection with the public playgrounds. As might be expected, the majority of bathers at the city baths, especially the open-air places, are of European nationalities, but the proportion is so much larger than the number of Americans that it is notable. Investigation shows that not only the Italian, but the Bohemian, Hungarian, the Pole and other classes composing so many of the work people in the greater cities have such a zest for bathing that in the season they come to the baths literally in throngs, so that one may find the water occupied almost entirely by persons who as yet can not speak a word of English, but are expressing their pleasure and delight in a jargon of tongues.

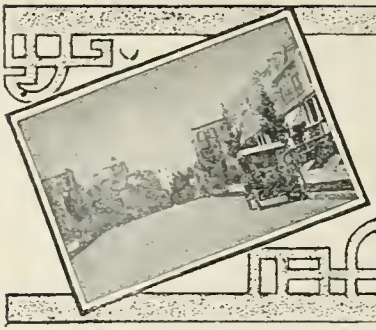
"Boston forms an excellent illustration of the fact that the foreigner takes to the bath not only for enjoyment but for cleanliness and health, and it has a great influence on him for civic betterment. Such a number began to patronize the public baths in this city, especially the sea-water baths, when the present season opened, that the officials in charge soon found their facilities for giving baths taxed to the utmost. It had been supposed that the habits of these people were such that they would be averse to going into the water, but the reverse is the case, as shown by the testimony of the men in charge. Citing the various public parks having open-air baths, the superintendents of these baths, men who for the most part have served from ten to fifteen years at their stations, have seen this group of foreign-born patrons, starting with a mere handful a few years ago, swell to proportions which threaten to outgrow the resources of the department. They have noted the changing character of the crowd and have been the ones to report last season and this the noticeable increase of the foreign patronage.

"It will be noted that, while the foreign element monopolizes the baths during a considerable portion of the bathing hours, they are at the same time patronized by the better classes and the Americans—but only when the latter can get a chance to have their exclusive use. The professional and business men have been forced to suit their bathing hours to a time when the others can not be present on account of being at work, and the situation in Boston has aroused such a feeling that those whom we might call American-born are now appealing for baths exclusive to themselves, altho as yet they have not succeeded in securing such facilities at the public expense.

"Social settlement workers and others interested in the uplifting of the tenement districts in the cities all acknowledge that the opportunity to bathe daily if desired has already had a very beneficial effect upon the foreign element, including all the nationalities. It has tended to make them more cleanly in their homes, also in the shops and factories, and has undoubtedly made them more self-respecting.

"In neighborhoods where the majority of the people patronize these bathing places it is noticeable that when they appear on the streets they are neater in their attire, and the women take more pride in the appearance of their homes both inside and outside.

"From the medical standpoint this increase in the use of water at the public expense has done much to lessen the percentage of so-called hot-weather diseases, especially among children, and the city and other physicians acknowledge that it has been a great benefit from a hygienic standpoint. The health board of Chicago has also made a study of the effect of bathing on an extensive scale as provided by the public baths in parks and on the lake front, and has come to the same conclusion."



MISCELLANEOUS

The Boston Convention of the American Society of Municipal Improvements

The American Society of Municipal Improvements celebrated its twenty-first year by the largest convention in its history and one of the most valuable. Owing to the amalgamation with the Association for Standardizing Paving Specifications and the desire to reconcile the differences between the standard specifications heretofore adopted by the two societies, all the specifications were up for consideration. While the necessary changes were slight, they required considerable discussion and the time of the general committee on standard specifications was fully occupied with them from Monday morning until Friday. The results were full sets of specifications from all the sub-committees, all of which were adopted by the association as modified during the discussions before the general committee, except those for wood block pavements and asphaltic concrete, which were reported by the general committee to be unfinished. The committee on asphaltic concrete was given three months to complete its report for publication and distribution preparatory to the discussion at the next convention. The other sets of specifications will be published at once and can be obtained from the secretary within about twenty days.

The convention opened with addresses from Mayor James M. Curley, Col. William D. Sohier, chairman of the Massachusetts state highway commission, and Norman S. Sprague, a vice president of the society. The convention got down to business immediately and under the prompt leadership of President Christ, completed the rather full program on schedule time without cutting off discussion of any subject.

The program printed last month was followed with some additions. Several of the papers mentioned are given in this number of MUNICIPAL ENGINEERING as fully as space allows and others will be given later.

The publication of the volume of proceedings was delayed until receipt of the delayed committee report.

On Monday there was some complaint of lack of opportunity for discussion of specifications before the committee, but this was fully remedied on the following days so that there was but little discussion of the specifications when they were presented to the convention and, with the delay of action concerning two sets of specifications, the expressions of satisfaction with the treatment accorded them were general. One outside complaint is considered in the editorial department.

The inspection and entertainment features of the convention were on a scale commensurate with the reputation of the city of Boston, with unusual weather as an efficient ally. Both the harbor and the automobile trip were of unusual interest and the many trips taken by small parties were quite as instructive as the convention sessions. The programs were so arranged as to devote each session as nearly as possible to a single group of subjects to give the members opportunities for these special trips.

According to custom, the officers were moved up one step, W. A. Howell, of Newark, N. J., becoming president, and A. F. Macallum and N. S. Sprague, first and second vice presidents, E. L. Dalton, of Dallas, Tex., being elected third vice president. Charles C. Brown and W. B. Howe were re-elected as secretary and treasurer. Dayton, O., was selected as the next place of meeting.

The exhibit of materials and machinery used in public improvements was more than usually large and included the products of the following firms:

Better Roads and Streets, Jamestown, O.
Standard Oil Company, Boston, Mass.
Robeson Process Company, Pennington, N. J.
Warren Brothers Company, Boston, Mass.
Municipal Journal, New York, N. Y.
National Brick Manufacturers' Assn., Cleveland, O.
Barrett Mfg. Company, New York and Boston, Mass.

Dunn Wire-Cut-Lug Brick Company, Conneaut, O.
The U. S. Asphalt Refining Co., New York, N. Y.
The Barber Asphalt Paving Co., Philadelphia, Pa.
Headley Good Roads Co., Boston, Mass.
C. L. Berger & Sons, Boston, Mass.
Engineering Record, New York, N. Y.
Lock Joint Pipe Co., Ampere, N. J.
Union Oil Co. of Calif., Chicago, Ill.
American Tar Co., Boston, Mass.
Buffalo Steam Roller Co., Boston, Mass.
Good Roads Magazine, New York, N. Y.
Bauch & Lomb Optical Co., Rochester, N. Y.
Dyar Supply Co., Cambridge, Mass.
Good Roads Machinery Co., Boston, Mass.
Jennison & Wright Co., Toledo, O.
U. S. Wood Preserving Co., New York, N. Y.
Warner-Quinlan Paving Co., New York, N. Y.
Wern Stone Paving Co., New York, N. Y.
The Sanitation Corporation, New York, N. Y.
Engineering News, New York, N. Y.
American Sewer Pipe Co., Boston, Mass.
Frank Ridlon & Co., Boston, Mass.
Universal Road Machinery Co., Kingston, N. Y.
Municipal Engineering, Indianapolis, Ind.

Conference on Industrial Welfare and Efficiency

In accord with the unanimous vote of the first Pennsylvania Industrial Welfare and Efficiency Conference, held in Harrisburg last year, John Price Jackson, Commissioner of Labor and Industry, has issued a call for a second conference, to be held in the State Capitol at Harrisburg on the 17th, 18th and 19th of November, 1914. This conference is held under the auspices of the Pennsylvania Department of Labor and Industry and the Engineers' Society of Pennsylvania. The purpose of the conference is to enable the employers and employes to work out together the great problems before them with reference to increasing the welfare of the employes and the prosperity of the industries.

The conference last year was the most unique and helpful of its kind ever held in the United States. It was attended by approximately two thousand persons, many of whom were leaders in the labor and industrial world. The gathering this year bids fair to have an even larger attendance and to create even more interest than that of last year.

The first session of the conference will be called at 10 a. m., on Tuesday, November 17, and the meetings will close at 5 p. m. on November 19. The various sessions of the conference will be held in the State Capitol, Harrisburg. In connection with the conference proper will be held an unusually effective safety, welfare and efficiency exhibition, which bids fair to be the best of its kind ever held in this country. This will open on the morning of November 16 and close on the evening of November 20.

Technical Schools

The non-resident lecturers in the graduate course in highway engineering at Columbia University appointed for the 1914-1915 session are as follows: John A. Bensel, New York state engineer; Edward D. Boyer, cement and concrete expert, the Atlas Portland Cement Company; Sumner R. Church, manager research department, Barrett Manufacturing Company; William H. Connell, chief Bureau of Highways and Street Cleaning, Philadelphia; W. W. Crosby, chief engineer Maryland Geological and Economic Survey, and consulting engineer; Charles Henry Davis, president National Highways Association; Arthur W. Dean, chief engineer Massachusetts Highway Commission; John H. Delaney, commissioner New York State Department of Efficiency and Economy; A. W. Dow, chemical and consulting paving engineer; H. W. Durham, chief engineer of highways, Boro of Manhattan, New York; C. N. Forrest, chief chemist Barber Asphalt Paving Company; Walter H. Fulweiler, chief chemist United Gas Improvement Company; D. L. Hough, president the United Engineering and Contracting Company; William A. Howell, engineer of streets and highways, Newark; Arthur N. Johnson, highway engineer, Bureau of Municipal Research, New York; Nelson P. Lewis, chief engineer Board of Estimate and Apportionment, New York; Philip P. Sharples, chief chemist Barrett Manufacturing Company; Francis P. Smith, chemical and consulting paving engineer; Albert Sommer, consulting chemist; George W. Tillson, consulting engineer to the president of the Boro of Brooklyn, N. Y.; George C. Warren, president Warren Bros. Company.

Wentworth Institute, Boston, Mass., has issued a catalog, showing among the new developments a course in foundry management and operation. The institute has just finished a new building, nearly doubling its available space.

"Magnetic and Other Properties of Electrolytic Iron Melted in Vacuo," by Trygve D. Yensen, has been issued as Bulletin No. 72 by the Engineering Experiment Station of the University of Illinois. The bulletin shows how it is possible to produce iron of an exceptionally

good magnetic quality by melting pure iron in a vacuum furnace. While iron melted under other conditions is apt to be contaminated by carbon or oxygen to a greater or less extent, iron melted in vacuo is not only prevented from absorbing such impurities, but is actually purified in the process. These facts are illustrated by a large number of curves as well as by numerous photographs showing the crystalline structure of the iron.

"Acoustics of Auditoriums," by F. R. Watson, has been issued as Bulletin No. 73 of the Engineering Experiment Station of the University of Illinois. The bulletin describes the acoustical defects of the auditorium at the University of Illinois, showing graphically in the illustrations the character and paths of various echoes, which were traced by use of an alternating current arc light at the focus of a parabolic reflector, the arc giving forth a hissing sound and the paths of the echoes being located by means of the reflected light and confirmed by means of the sound. A cure for the acoustical defects was found without changing materially the architectural design of the room. The bulletin should be of value to architects and others interested in this subject.

"The Thermal Properties of Steam," by G. A. Goodenough, has been issued as Bulletin No. 75 of the Engineering Experiment Station of the University of Illinois. The bulletin presents a critical discussion of the experimental investigations of the various thermal properties of steam, an outline of the thermodynamic relations that must be satisfied, and, finally, the development of a general theory of superheated and saturated steam. As a basis for such a theory the well-known Munich experiments on specific volumes and specific heats are taken and properly correlated thru the Clausius relation.

Latin American Trade Situation

That Latin American countries are looking to the United States for the capital and the market for their products which they formerly found in Europe is emphasized in "Statements on the Latin American Trade Situation," a pamphlet just issued by the Bureau of Foreign and Domestic Commerce of the Department of Commerce, giving the addresses made by representatives of Latin American countries at a conference with American business men recently held in Washington. The pamphlet, issued as Miscellaneous Series No. 18, contains the statements made by the ministers from Bolivia, Uruguay, Peru and Cuba to the United States, the consuls general of Costa Rica and Colombia in New York, the minister from Ecuador to England, and others, besides the opening remarks of Secretary of State William J. Bryan, and a statement by Secretary of Commerce William C. Redfield. Many obstacles to the development of Latin American trade with the United States were commented on, notably the matter of credits and that of a proper understanding of the Latin American way of doing business on the part of business men in the United States. The pamphlet is for sale by the Superintendent of Documents, Government Printing Office, Washington, for 5 cents.

Civil Service Examinations

The U. S. Civil Service Commission will hold examinations at the usual places, as follows:

November 17—Oil and gas inspector, mapping wells in Oklahoma under Bureau of Mines, at $1,800 to $2,160 a year, and on well records, at $1,800 to $2,400 a year.

November 18—Junior explosives engineer in Bureau of Mines, Pittsburgh, Pa., at $1,200 to $1,500 a year.

December 1—Engineering inspector, oil and gas, in Oklahoma, under the Department of the Interior, at $2,160 to $3,300 a year.

Technical Associations

The November meeting of the New England Water Works Association will be held at Hotel Brunswick, Boston, Mass., November 11. The papers will be by Max von Recklinghausen on the sterilization of water with ultra-violet rays; by Sheppard T. Powell, on the use of ozone as a sterilizing agent for water purification, and by B. M. Wagner, on water rates. There will be a topical discussion on service pipes, led by E. C. Brooks and F. F. Forbes. Willard Kent, secretary, 715 Tremont Temple, Boston, Mass.

The fourth American Road Congress of the American Highway Association will be held in Atlanta, Ga., November 9-14. A. B. Fletcher, president, Sacramento, Cal.; I. S. Pennybacker, executive secretary, Colorado building, Washington, D. C.

The location of the exhibition of street cleaning appliances, to be held in New York under the auspices of J. T. Fetherston, commissioner of street cleaning, has again been changed to give sufficient room for the exhibitors, and will be held in the armory of the First Regiment Field Artillery, Broadway and Sixty-eighth street, Manhattan.

The American Road Builders' Association will hold its annual convention and road congress in Chicago, beginning December 14. The exhibit held in connection with the meeting is always a valuable feature.

The League of California Municipalities held its annual session at Monterey, beginning October 12.

The Society for Electrical Development has awarded thirteen prizes for stories presented in a recent competition, one being $250 to Roscoe E. Scott, of the National Lamp Works of the General Electric Company, Cleveland, Ohio; another of $150, to Don C. Shafer, of the General Electric Company, Schenectady, N. Y.; one of $50, to George S. Burdick, Scranton Electric Company, Scranton, Pa., and the others of $10 and $5 each.

The next convention of the Society for the Promotion of Engineering Education will be held at Iowa State College, Ames, Iowa, June 22 to 25, 1915, Dean A. Marston, of the College of Engineering, being president of the society.

The Municipal Engineers of the City of New York inspect the Hempstead aviation field, Garden City, L. I., on November 7, including the machines in the hangars and the aero motors, of which there are several in the machines. The society gives a trophy to the winner in a general efficiency test for altitude and speed.

The fire alarm system of New York was described to the Municipal Engineers of the City of New York by Putnam A. Bates, chief of the Bureau of Fire Alarm Telegraph, at their meeting on October 28.

At the meeting of the Cleveland Engineering Society on November 10, Ward Harrison, illuminating engineer, with the National Lamp Works of the General Electric Company, Cleveland, Ohio, will read a paper on "A New Era in Street Illumination."

Personal Notes

Joseph W. Goss has resigned as deputy city engineer of Sacramento, Cal., to accept the position of office engineer for the California State Highway Commission. Mr. Gross graduated in civil engineering from the University of California in 1907.

F. N. Holmquist, formerly city engineer of Phoenix, Ariz., has opened offices in the Noll building, 124 First avenue, Phoenix, as a civil engineer.

J. M. Slater has been appointed street commissioner of St. Louis, Mo., and will have charge of the repairing, cleaning and maintenance of streets, alleys, bridges, wharves and levees, the sprinkling of streets, collection and disposal of garbage and refuse, etc.

Robert E. Kremers has been appointed chief of the Bureau of Highways and Bridges of Portland, Ore.

Herman G. Farr has resigned as chief engineer of the Knox Motors Company and will open an office in Springfield, Mass., as consulting engineer. Mr. Farr is one of the best-known automobile engineers in the country and a pioneer of the industry, having, in conjunction with Harry A. Knox, designed one of the first successful gasoline cars in America. He has been with the Knox Company since it started fifteen years ago. His wide experience well fits him for his new work.

Publications Received

The Board of Street and Water Commissioners of Newark, N. J., has issued a synopsis of the bay front development and meadow reclamation project of the city, on which it has been authorized to spend $2,000,000. The city now has nearly 400,000 population and is rapidly growing, and needs the new dock and factory site facilities, ship channels, piers and railroad and transfer systems which this work will make possible.

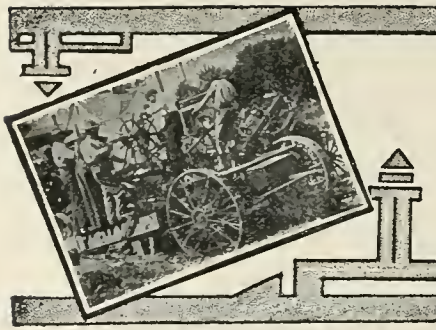
Report of the executive committee of the Municipal League on the Los Angeles city school department, October 13, 1914.

Strauss' Data Cards have now reached thirty-two in number. They are published at frequent intervals by H. A. Strauss, Harris Trust Building, Chicago, Ill.

A study of the Oxidation of Coal, by Horace C. Porter and O. C. Ralston, Technical Paper No. 65 of the Bureau of Mines, U. S. Department of the Interior.

"The Gate City of the Sunny South" is an enthusiastic appreciation of Atlanta, Ga., by Adolph M. Schwarz, an attorney of that city.

Bulletin General No. 425, of the University of Wisconsin, is from the extension division for aid in debating and public discussion, and gives a synopsis of arguments on both sides of these subjects with references to books and articles on them.



MACHINERY AND SUPPLIES

The Buckeye-Mobile

The Buckeye Engine Company, Salem, O., have developed a new engine which will develop a brake horse-power on less than 1.5 pounds of coal per hour.

Each unit is self-contained, boiler and engine being mounted together, and electric generator, if used, being immediately alongside.

The first unit installed is a 115-h.p. boiler and engine set in the basement of the works of the International Cork Company, Greenpoint, L. I., New York. The height from base to top of flywheel is 9 feet, length 17 feet 10 inches, requiring, in all, 32 feet 6 inches, including space required to remove tubes at head end and superheater at rear end, the space in front being required also for firing. The width is 7 feet 6 inches, and a generator with foundation adds 6 feet to the width, thus making 13 feet 6 inches by 32 feet 4 inches ground space and 9 feet height required for 115-h.p. output.

Several 225-h.p. units have been installed for the O. C. Barber Companies at Barberton and Canton, O.

Full descriptions of these engines and of the full line from 75 to 600-h.p. sizes will be found in Bulletin 111B and Special Bulletin No. 2 of the Buckeye Engine Company, Salem, O., who will send them on request.

Available Suggestions to Manufacturers

Naturally a company as conspicuous in industry as the Goodyear Tire and Rubber Company is a target for inventors of high and low degree. One of the duties of the experiment department of the company is to handle, pass upon and dispose of the thousands of suggestions that are presented, and all of which, their inventors believe, will revolutionize the tire business and bring wealth and happiness as the reward for originality. Letters and suggestions to Goodyear from inventors and others average three or four a day, all the year around. They come from all parts of the country and from foreign lands as well. Fully 25 per cent. of the suggestions have been proposed again and again by others. The head of the Goodyear experimental department has thus classified the ideas presented:

	Per ct.
Utterly worthless	55
Of value, but previously proposed	25
New ideas which might be successful, but which do not offer enough advantages to justify costly experiments	20
Ideas which we actually try, but which do not make good	4½
Actually accepted	½

That most of the suggestions come from persons of little experience or technical knowledge of the subject is no reason in itself for rejecting them. Sometimes such a person, having a broad perspective rather than an intimate knowledge, may hit upon very valuable ideas which the trained expert may entirely overlook. This department gives every idea sent in equally careful consideration, and, in judging the merits of a device, avoids the expression of personal opinion, but gets the facts of the case from the best authorities available.

Gypsum Products

The Red Book of the U. S. Gypsum Company is a mine of information regarding the building materials in which gypsum is used. It gives full information about the various grades and brands of gypsum plasters made and sold by this company, specifications for various work in which they can be used, methods of measuring areas and quantities required, etc. A considerable part of the booklet is devoted to Sackett plaster board, which takes the place of wooden lath, and Pyrobar gypsum tile, which can be used instead of clay tile for fire-proofing. Both these products are described at full length and their various uses are illus-

trated by text, drawings and photographs.

The book is well worth careful study, and can be obtained for the asking of the U. S. Gypsum Company at their Chicago office or at any of their branch plants, warehouses, stores or agencies.

Export Goods Must Be the Best

"In the wonderful opportunities that are opening up for the extension of our export trade thru the disorganization of foreign industries by the war, the American business man should not overlook the infinite importance of making permanent the advantages we may gain," says President George A. Kissel, of the Kissel Motor Car Company.

"This can be completely accomplished only by seeing to it that the products we ship abroad are the best that sound materials, skilled workmanship and careful supervision can make them.

"When demand is acute and quick delivery insistent, temptation is greatest to fill in with 'seconds' and 'shoddy.' But no American business man who has the future commercial welfare of his country at heart will yield to it, even tho his customer, in haste to receive the goods, is made cognizant of their defects.

"In short, everything that finds its way abroad with a U. S. label attached, or with a U. S. manufacturer as sponsor, should be so sterling a value that wherever it is shown and tested its superiority will be obvious.

"We recently filled an order for a large fleet of KisselKar trucks from the government of Greece. It was a time order, with a stiff penalty attached for every day of delay. Yet we did not accept this order until thoroughly satisfied that we could fill it without the sacrifice of a single detail of that same care and inspection taken with the most important domestic order. We look upon this method as a plain business duty, not only to the buyer, but to ourselves. We expect to keep on doing business in Greece—that is a reason sufficient in itself."

A Safe Fence For Bear Pit

One of the difficult designs for a park or zoo is the fence for the bear pit, as bears are able to surmount very difficult obstacles.

The accompanying photographs show a successful fence built for the Brookside Zoo of the city of Cleveland.

The work consisted of eight cages, requiring in all 800 feet of exceptionally heavy fence. This fence was made with ¾-inch square pickets with 2½-inch channel rails. The pickets were set diagonally in the rail and curved over at the top on an 18-inch radius. The ends of these pickets are forged to a sharp point and are reinforced with a 2½-inch angle. The main posts and wall are of nigger heads. The

BEAR PIT *fence which prevents the development of Bruin's strong propensities for climbing.*

BEAR PIT *at the Brookside Zoo, Cleveland, O., of specially handsome and safe design.*

intermediate posts for the interior fence are of 3-inch I-beams with forged sharp points. The posts extend into the ground about 4 feet and are set in concrete. The partition panels are constructed with every other picket curved in the opposite direction, so as to absolutely prevent the animals from climbing over the work. The gates in the exterior cages are of the swinging type and are so arranged as to close automatically.

The interior of the dens is very cleverly constructed, the arrangement of the doors being such that any part can be isolated at the will of the keeper. These doors are of the sliding variety and are also arranged that they are automatically closed or can be held open at the will of the operator. At the rear and top of the masonry is an additional barrier, constructed of ¾-inch square pickets, with 2½-inch channel rails, the pickets curved in at the top as on the balance of the work. This rail is securely fastened to the masonry by means of lead bolts.

Entirely surounding the cage work there is 1,600 feet of plain forged top fencing 5 feet in height. This fencing sets 4 feet away from the cage work and prevents spectators from annoying the animals. This fencing is constructed of ¾-inch square pickets with 2 by ⅝-inch channel rails. The pickets are spaced 5 inches center. The fencing is attached to the concrete sidewalk.

It is a well-known fact that bears are able to get out of almost any enclosure and it was the general impression that this cage work would have to be entirely covered over to prevent their escape. After one or two attempts the bears have made no further efforts to get out of these enclosures, and the idea of covering the top has been entirely abandoned.

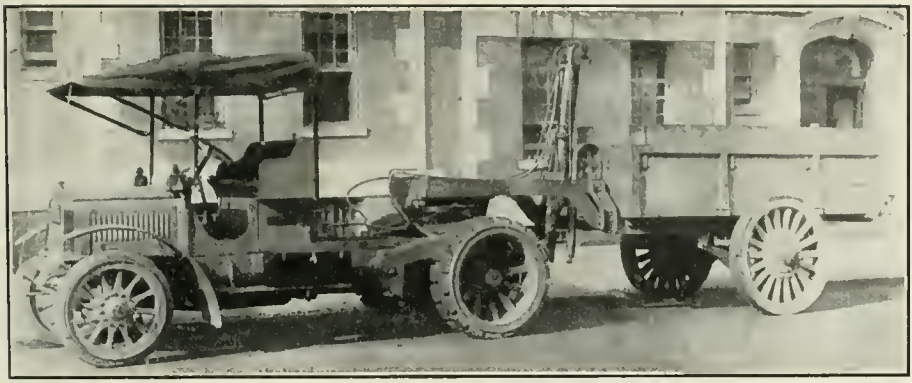
The work was designed by Stinchcomb & Boddy, landscape engineers, and was executed by the Van Dorn Iron Works Company, of Cleveland.

Special Five-Ton Saurer Tractor and Trailer For Handling Hot Asphalt and Contracting Material

This 5-ton Saurer tractor-trailer dump outfit, a product of the International Motor Company, has recently been placed in service by the Borough Asphalt Company, Brooklyn, N. Y.

This truck is used in connection with a special dump trailer, which is an innovation. The trailer body has a capacity of 5 tons, or 100 cubic feet, and is equipped with a Wood hydraulic hoist, dumping from the rear. It is unusual to mount an automatic dump mechanism on a trailer. The body is of wood 10 feet 6 inches long, 4 feet 6 inches wide at front; 5 feet wide at rear, 2 feet high, lined with sheet steel on the inside, with a ½-inch asbestos lining between the wood and steel sides, and is designed to carry hot asphalt, broken stone and sand. The dump mechanism of this trailer body is controlled from the driver's seat on the tractor, and raises the body 45 degrees. The oil pump for operating the hydraulic hoist is mounted on the driving shaft, and the fluid is forced back into the hoist on the trailer thru flexible pipe connections.

Most trailers have the dump arrangement at the bottom, but for a number of reasons it is not advisable to handle hot asphalt in this manner. There would be considerable disadvantage in closing the dump opening if hot asphalt was dumped



FIVE-TON AUTOMOBILE TRUCK, *with trailer, for hauling asphalt mixture to the street for laying, operated by the Borough Asphalt Co., New York. Note rear dump by means of the mechanism at front of the dumping body.*

thru the bottom, owing to the clinging nature of this substance, which prevents tight closing. It is necessary to have a very tight body for transporting hot asphalt, as it is handled at a temperature of 300 degrees and must be kept hot until worked into position on the street.

The Borough Asphalt Company are very active in the use of tractors and trailers in their paving and road construction work, and are getting fine results from their Saurer tractors, of which they now have seven.

Trailer outfits of this nature give greater flexibility of operation and permit heavy loads to be handled in rugged service where it would not be possible for a truck with a capacity load to pull out.

Important in this Saurer tractor-trailer construction is the universal coupling which links the two units together. This connection is by a type of "fifth wheel," which the International Motor Company is using with great success, and which permits quick attaching and demounting.

The wheel base of the Saurer tractor is 10 feet 8 inches.

Exclusive of the Saurer chassis, cost of the trailer outfit complete, including "fifth wheel," hydraulic hoist and pipe connections, body, frame and trailer wheels, is $1,200.

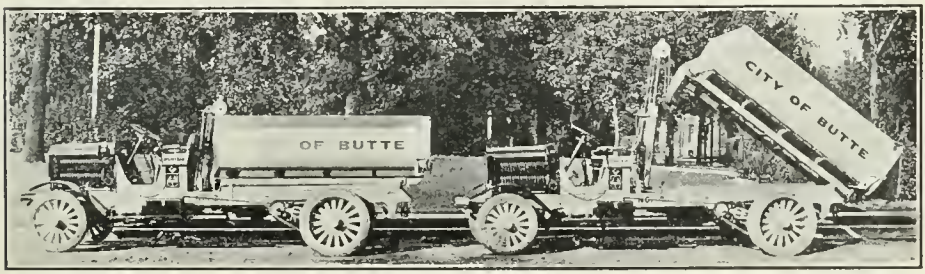
KISSELKAR *gravel trucks of the city of Butte, Mont., of 3½ tons capacity.*

Kissel Trucks Carry Overload Regularly

Two Kissel trucks, 5-ton capacity, were operated under a 20 per cent. daily overload on a long haul for over a year. They each brought two 6-ton loads of lumber per day from the yards at the port of Wilmington to the city yards of Ganahl Lumber Co., or to a job in progress. This involved more than 80 miles a day, one way empty, the other under overload.

Automatic Sprinklers for Fire Protection

One of the approved systems for fire protection is the Evans system of sprinkler heads, dry valves and alarm valves made by the Merchant and Evans



Co., Philadelphia, Pa. To meet all needs of those wanting this most effective method of protecting goods from fire, whether in fireproof buildings or not, the Merchant and Evans Co. have developed a selling system which gives the purchaser every opportunity to obtain what he wants at a minimum of cost and on easy terms, thus they will sell the sprinklers outright for installation by the owner; will make the installations themselves or thru their accredited licensees at prices bid; or on a basis of cost plus a percentage; or will make full surveys, drawings and plans for reasonable engineering charges for opening the work to competitive bids; or will exchange for old heads in use, making the best current allowance for the old material.

A Refrigerator Motor Truck for Dairy Products

A 1,500-pound KisselKar owned by the Edgewood Farms, of Newport, Minn., and made by the Kissel Motor Car Company, of Hartford, Wis., is equipped with a refrigerator which insures keeping cool and sanitary the bottled milk and milk in cans which this truck carries. The body is of the panel type and is constructed of sheet steel and besides being very rigid, is of pleasing lines, the top being carried forward over the driver's seat in a slight curve.

The body has four doors, a double door being provided at the rear and a single door large enough to permit of the loading of the standard 10-gallon milk can on each side, directly to the rear of the driver's seat. Besides being used for loading and unloading the 10-gallon cans of milk, these side doors are also used to remove bottled milk, butter and cheese, which are carried on shelves directly below the refrigerator, which is attached to the forward end of the body.

The refrigerator is positioned directly beneath the roof. It is supported by uprights at its rear side, which also act as supports for the shelves which are placed beneath the refrigerator. The latter is zinc-lined and as a further protection against radiation is enclosed on all sides within several inches of charcoal. Its capacity is 300 pounds of ice. The water resulting from the melting of the ice in the refrigerator is drained off thru a small pipe which extends downward from the bottom of the refrigerator in back of the shelves and thru the floor of the body to within a foot of the ground.

The shelves for carrying the bottled milk and butter are six in number and are placed one above the other beneath the bottom of the ice box. Besides the air cooled by direct contact with the refrigerator, these shelves are also cooled by the cold water passing down thru the refrigerator drain pipe to the ground.

The outside appearance of the body is very pleasing to the eye, it being painted with white enamel, highly polished, and the name of the owner painted in gold letters.

The inside length of the body is 8 feet, and the inside height, measured on the center line, is 5 feet and 6 inches.

Wire-Cut-Lug Brick Has Phenomenal Popularity

In the five seasons beginning in 1910 and ending with October 1, 1914, covering not much more than four years of time, the development of the use of wire-cut-lug blocks has been so phenomenal that the total distribution of the blocks now amounts to 151,316,534. The progress in road and street building in the various states, influenced to some extent by the relative sizes of the states, is shown by the following table, giving the number of wire-cut-lug blocks distributed to each state:

New York	65,903,876
Ohio	36,149,271
Illinois	16,429,290
Pennsylvania	10,246,337
Maryland	6,320,300
Indiana	5,960,110
Canada	2,914,200
Kentucky	1,816,300
Michigan	1,543,700
North Carolina	973,350
New Jersey	886,500
West Virginia	634,300
Florida	479,800
Tennessee	366,000
Georgia	356,400
South Carolina	320,400
Wisconsin	7,400
Connecticut	5,000
Virginia	4,000

Concrete Mixer Earns Large Bonus in South America

The specifications for the installation of weighing equipment for the government of Uruguay at the port of Montevideo provided that the furnishers of the weighing equipment had to make delivery and to have erected all the equipment within three months. The contract also contained a proviso that a bonus of $5.00 per day per weighing device was to be paid in which the specified date of completion was anticipated, and a like penalty forfeited for every day beyond the specified date for completion of contract.

It required about six weeks to transport the equipment, materials had to be as-

sembled, pits had to be dug and foundations laid before any of the weighing equipment could be installed. The work had to be done with the utmost care, since the entire imports and exports of Uruguay, amounting to $85,000,000, pass thru this port, and all must be weighed.

The "Standard" concrete mixer was used and was ready to run onto the job upon its arrival, as they are completely assembled ready for operation when they leave the factory.

The drums are charged low at the base, so that direct charging from the barrows saves the need of having a loading skip. The point of charging is only 24 inches above the ground. The Standard Scale and Supply Co., Pittsburg, are the makers of the line of mixers.

Asbestos Expansion Joint

The H. W. Johns-Manville Co. is manufacturing an expansion joint felt of asphalted fiber containing asbestos, which can be used with success in filling the expansion joints in concrete, brick and wooden block pavements. It is made in ¼ and ⅛-inch thicknesses and has been in use long enough to demonstrate its value and durability. Asbestos is not decomposed by age.

Motor and Bicycle Tire Business is Increasing

Today desirable publicity regarding motor vehicle tires has more value when based on actual use and service. For that reason there is interest in the tire census taken by *Rider and Driver* of the 3,159 cars gathered at the opening of the Belmont Park race track last spring. This was naturally a showing of big cars, automobiles of the most expensive makes, and the tire equipment indicated, in a way, the preference of those who are more interested in tire service than in the cost of the tires themselves. Every tire was tabulated in the paper's count, spares included, a total of 16,006. It so happened that in this select aggregation Goodyear led its nearest competitor by 198 tires, and had approximately fourteen per cent. of the total equipment, divided among thirty makes.

This year three out of every four motorcycles are Goodyear equipped. The same proportion will continue in 1915. The company gives six strong reasons for this: Goodyear tires will have stronger beads than ever before. They will have gum strips between plies at the splices, same as Goodyear automobile tires. A still more durable tread stock has been evolved for the '15 product. The feather edge of the flap has been perfected. Every Goodyear tube will carry a valve spreader, and the tubes themselves will be heavier than ever before.

But one style of bicycle tire will be made, the best. And more bicycles are in use this year than ever before. The business has been increasiug annually until it is approaching the phenomenal production of the years when bicycling was most popular.

Taxicab Test of Tires

The Terminal Taxicab Company, of Washington, purchased twenty-one 34x4-inch Goodrich safety tread tires last January, and kept complete records on service delivered by these tires.

A report of detailed figures shows that these twenty-one tires had averaged 5,707.9 miles up to and including June 16, and that nine of them at that time were still in service and delivering even greater mileage than this high average.

The continuous starting and stopping of a taxicab during the day's activity is the hardest and roughest service to which a tire can be subjected. In fact, the taxicab test is the supreme test for any tire and the showing made by Goodrich safety treads in this severe day-to-day grind is further proof of the mileage and service delivered by the safety tread construction.

It is the five-bars and cross-tie, tough rubber fingers which grip the road at the same time that they deliver extra wear, which are accountable for Goodrich safety tread extra mileage, as shown at Washington.

Domestic Refuse Destructor

The Atkinson-Morse Destructor Co., 30 Church street, New York, make and install a small refuse destructor for the use of hospitals and similar institutions, and for use in private estates, summer homes and camps, where the output of waste is not sufficiently large to warrant the maintenance of a continuous fire.

It is cylindrical in form, about 5 feet high by 2 feet in diameter, made of steel casing with cast iron base and top, with doors for charging the waste and fuel, and removing ashes. The lower section carries a cast iron shaking and dumping grate on which the initial coal or wood fire is made, and where the combustion of material takes place.

The whole interior is lined with the most refractory firebrick and provided with a special series of transverse fireclay bars thru which the smoke and the gases must pass and are consumed by contact with the highly heated firebrick surface. In the dome can be placed a coil for heat-

ing water which will be equal to providing from 100 to 200 gallons of hot water per hour.

The apparatus is strong and durable, can be operated by any person with the minimum of attention, can be connected, when set in the cellar of a building, with the chimney-flue of any house, or, when used out of doors, must be provided with a vertical smoke pipe 7 to 8 inches in diameter and from 30 to 40 feet in height. In this case there should also be a small covering house to protect the furnace from the effects of the weather.

Evidence as to Pavements

Several million yards of Trinidad and Bermudez sheet asphalt pavements that have given a service of twenty years or more are illustrated and described in a booklet entitled "Evidence," published by The Barber Asphalt Paving Company. A score of cities are represented and wherever maintenance data were obtainable they have been given, along with the date the pavement was laid, and a photograph showing its present condition. The oldest of the pavements so described is the Trinidad sheet asphalt pavement on Vermont avenue, Washington, D. C. It is thirty-five years old. Something more than 1,000,000 square yards of asphalt paving in Washington, D. C., averaging twenty-three years of age, has cost 1.8 cents per yard per year for maintenance. New Orleans has several thirty-year-old pavements. Buffalo has 1,200,800 yards of sheet asphalt twenty years of age or more and still in use. Among other cities that contribute to the census of more-than-twenty-year-old pavements are New York, Philadelphia, Boston, Chicago, St. Louis, Cincinnati, Columbus, Detroit, Omaha, Charleston, S. C., Savannah and Louisville.

Trade Notes

The C. & C. Electric & Mfg. Co., of Garwood, N. J., manufacturers of electric motors, generators and electric-arc welding equipment, announce the removal of their Detroit offices from 144 Seyburn Ave., to 1111 Chamber of Commerce Bldg. This office is in charge of R. K. Slaymaker. A new branch sales office in the Security building, Minneapolis, Minn., has been put in charge of R. L. Wells.

Concrete piles for the foundations of the New York American Building; loft building for Mullins Bros.; for the new elevated structure in connection with the subway extension at Long Island City, in New York City; for the Steuart-Knatz warehouse, Baltimore, Md.; for the foundation of the Division pumping station, Cleveland, O.; of East Kansas avenue bridge, Kansas City, Kans., and office building for the East Ohio Gas Company, Cleveland, O., will be furnished by the Raymond Concrete Pile Company.

The prospects for the Panama-Pacific International Exhibition, to be held in San Francisco in 1915, are for prompt opening, with exhibits practically in place. A recent recital of the exhibits actually on the way shows that the countries of the world will be very generally represented and that the war does not affect the number and kind of exhibits except from a small area in Europe.

The MacArthur Concrete Pile and Foundation Company will furnish concrete piling for the foundations of the Firemen's Fund Insurance Company's building, San Francisco, Cal.; of the one-half million cubic-foot gas holder of the Empire Gas and Electric Company, Auburn, N. Y.; of the new warehouse of the American Dock Company, at Tompkinsville, Staten Island, N. Y.; for the Canadian Kodak Company's new power plant and boiler house, at Mt. Dennis, a suburb of Toronto, Ont.; for the First Congregational Church, Toledo, O.

The Merritt Hydraulics Company, Philadelphia, Pa., have the rights under the new patents on the Priestman natural compound pumping system for screening sewage and by-passing the screenings and pumping the finely screened sewage by high efficiency centrifugal or displacement pumps.

Trade Publications

The Kansas City Testing Laboratory, Kansas City, Mo., has issued Bulletin No. 7, which gives definitions and tables of equivalents of weights and measures, which is sold at 25 cents.

"Defeating Rust—The Story of Armco Iron," "Iron Roofs That Resist Rust" and "A Journey to Armco Farm" are the titles of three new publications on "Armco" products recently issued by the American Rolling Mill Co., of Middletown, O. In the booklet on the story of "Armco" iron are shown many illustrations of "Armco" iron used for roofs, ventilators, gutters, lath, window frames, stoves, refrigerators, culverts, pipes, etc. The booklet entitled "Iron Roofs That Resist Rust contains an article on why iron roofs resist rust and illustrations and descriptions of many forms of "Armco" iron used in roof construction. Rules for estimating amount of corrugated iron required to cover given spaces, tables of weights and list of products manufactured of "Armo" iron are also given in the booklet. "A Journey to Armco Farm" contains an interesting story of the various uses to which "Armco" iron is put.

MUNICIPAL ENGINEERING

The World's Leading Municipal Publication.

THE ROLLER SKATING TEST OF A SMOOTH PAVEMENT OF CONCRETE.

VOL. XLVII. DECEMBER, 1914. NO. 6.

Most Englishmen [and Americans] at heart prefer the worst of amateurs to the best of experts, and would rather be wrong with the one than right with the other. They will long persist in that preference and will long cling to the honest belief that the country's greatness is based upon it. —*William Harbutt Dawson.*

Published by

Engineering Publishing Co.

INDIANAPOLIS, IND.

New York Office:
1127 World Bldg.
GEO. H. CLINGAN,
Eastern Mgr.

Chicago Office:
1634 Marquette Bldg.
E. D. POWELL,
Western Mgr.

Entered at Postoffice, Indianapolis, as Second-Class Matter.

A. P. Fox, President. **C. C. Brown, Editor.** **C. S. Sale, Gen'l Mgr.**

Subscription Price in U. S. and Possessions, Cuba and Mexico, $2.00. Canada, $2.40. Foreign, $2.75.

Changes of address, subscriptions, remittances and editorial matter should be addressed to MUNICIPAL ENGINEERING, Indianapolis, Ind.

REFUSE DESTRUCTOR AT SAVANNAH, GA.

By E. R. Conant, City Engineer.

The city of Savannah recently completed a high-temperature refuse destructor, which has been operated long enough to give an idea of its efficiency and economy. The author describes also the special features in design and operation, which add to the satisfaction given by the plant. The article is abstracted from a paper before the American Society of Municipal Improvements.

EARLY in 1913 the writer studied the various methods of disposal of garbage and visited several cities where high temperature incinerator and reduction plants were in operation, and, after giving due weight to the various methods, recommended to the city the adoption of a high temperature incinerator plant, which recommendation was approved by the mayor and aldermen, and proposals were asked. After carefully considering the proposals received, a contract was made and entered into in July, 1913, with the Destructor Company of New York for a plant of the Heenan type, with a daily capacity of 130 tons.

The company made two proposals—one to furnish a destructor plant operated wholly mechanically with clinker chamber under the grate, at a cost of $170,000. The other proposal was to furnish a plant of the same general type at a cost of $125,000, with a different method of charging the furnaces and withdrawing the clinkers. With the higher price plant the guaranteed cost of operation was 29.30 cents per ton; with the lower cost plant 40.4 cents per ton. The guaranteed water evaporation for the $170,000 proposal proposal was 1.8 pounds of water to one pound of refuse consumed; for the $125,000 plant it was 1.34 pounds of water to one pound of refuse consumed.

While the guarantees for the higher price plant were inviting, the writer, for good reason, recommended the second or lower price proposal to be adopted by the city, and from results attained it would appear that the selection was the best. In considering the adoption of the high temperature plant, consideration was given to making use of all by-product steam that could be obtained by burning the refuse over that required by the plant for operating the plant to partially operate one of the city's water works pumping stations.

With this in view the plant was located on the city's property and adjacent to the pumping station. The distance between the buildings as constructed is but 60 feet, and the distance between the boilers of the destructor plant and where the steam is delivered to the main steam header in the boiler room of the water works is 140 feet.

In the destructor plant there are two 65-ton capacity per day Heenan type furnaces. Each unit comprises four cells about 28 inches wide on the bottom, 34 inches at the top, 16 inches deep, 8 feet long. Each unit has a separate charge combustion chamber, a 200-horse-power Wickes water-tube boiler and an air heater and cylindrical centrifugal fan for supplying forced draft. The cells are fitted with trough grates, which is a comparatively recent development, but is already quite extensively used in plants constructed by this company and by Heenan-Froude,

SAVANNAH REFUSE DESTRUCTOR. *Large pipe in the right foreground carries steam from destructor boiler to pumping engines of water works plant, thus saving fuel in that plant.*

Ltd., Manchester, Eng., who made the original design. The contract also covers a building to house the plant, a receiving pit of 260 cubic yards capacity for receiving the refuse, a regenerator or preheater, electric hoist for taking the material from the storage pit and transferring it to the containers, necessary instruments for measuring and recording conditions of the furnaces, wagon scale for weighing the refuse, a steam turbo or engine driven generator of 75-k.w. for supplying the necessary current for lighting the plant and operating the motor. The cells were so constructed as to have a burning area over each grate of 20 square feet, each boiler to have a heating surface of 2,000 square feet with a working pressure of 160 pounds per square inch. The stack, of radial brick construction, is 150 feet high and 6½ feet inside diameter at the top. The receiving storage pit as constructed in this plant has advantages over some that have been observed at other plants. It is 32 feet long, 20 feet deep and 11 feet wide. The greatest length is parallel with the beam supporting the crane carrying the hoisting grab bucket, and the bucket can reach any of the material in the pit by direct drop, without extra rehandling in the pit. Then,

again, the bucket can pick up any portion of the refuse dumped in the hopper and distribute it over the surface, if desired, to bring about a better mixture. The combustion chamber is of ample capacity and properly proportioued to receive and thoroly mix and burn all gases coming from the different cells discharging into it. There is ample space for the collection of dust in the chambers and a door to same is large enough to permit the entrance of dead animals.

A superheater, of the Foster type, superheats the steam generated by the boiler. The air heater is located immediately at the rear of the boiler. The supply of air for forced draft is taken from the ventilating system within the building. The containers into which the material is deposited from the grab bucket are arranged one over each cell of the furnaces. Each has a capacity of about one cubic yard and they are closed by horizontal sliding doors built in two parts. Each cell receives charges of about one cubic yard. The space above each grate is common to each cell and to the combustion chamber, so that there is free interchange of heat between cells. The main grates on which the combustion takes place are of heavy cast iron construction. They are perforated with a sufficient number of holes arranged to give proper distribution of air thruout the refuse and at the same time to secure the maximum cooling effect on the iron supports. The clinker car is of special design for receiving clinker as it is withdrawn from the furnaces.

Guarantees Made—The plant shall be capable of destroying in normal operation without adidtional fuel 130 tons of refuse in 24 hours. No odors or obnoxious gases shall escape from the chimney or the building. That at no time during the normal operation of the plant shall the temperature fall below 1,250 degrees F., and that an average temperature of 1,500 degrees F. shall be maintained in the combustion chambers. That the number of pounds of steam generated in the boiler from and at 212 degrees F. per pound of refuse consumed shall not be less than 1.3 pounds per pound of refuse consumed. That the net effective boiler capacity in horse power for steam utilization over

SAVANNAH DESTRUCTOR. *Grab bucket dumping refuse into containers above the furnace cells. These buckets take the refuse from carts and from pile.*

SAVANNAH DESTRUCTOR. *Dumping refuse from wagon and from grab bucket into the hoppers from which the furnaces are fed.*

and above that required for operating the plant will be 330 horse power, based on 34.5 pounds per boiler horse power. The cost per ton for the incineration based upon the schedule of wages to be paid and with force as required and set out in the specification shall not exceed 40.4 cents per pound. Another important guarantee is as to the number of pounds of refuse to be burned per hour per square foot of grate area upon which final combustion takes place. In this plant it is guaranteed not to be less than 68 pounds, which is a reasonable guarantee.

Total Cost of Plant—Some changes were made in the proposal received for the plant, and the contract with the destructor people, excluding the extras, was $120,000. Extras for excavation, concrete foundations, steam line from plant to pumping station, etc., paid contractor were $3,971. Cost of inspection and miscellaneous work done by city forces in connection with the construction of the plant was $2,300, making the total cost of the plant to the city $126,271.

Refuse brought to the plant is first weighed on wagon scales and is then dumped into the storage hopper at the ground level. The refuse is fairly well mixed and from there it is taken from the grab bucket operated by an electric transporter and delivered to the containers that are located over each cell of the furnaces. At the bottom of these containers is a solid door operated by hydraulic power, so arranged as to be convenient to the stoking floor, which enables the stoker to fill his grate in accordance with the requirements of his fire. Stokering is done thru a supplementary door, which avoids the necessity of opening the large door thru which the clinker is withdrawn.

The clinker formed on the grates is removed by semi-mechanical means. The sides of the grates diverge slightly from the rear to the stoking door. There is a large bar to which is fastened a plate which forms an upturned hoe laid on the bottom of the grate before the first charge is dropped upon it, and the clinker is pulled out bodily by power obtained from a hydraulically driven winch onto a hand-pushed car, which is pulled over a level paved surface to the dump. This method of clinkering permits of the clinker being

removed from the grate in from three to four minutes. The platform at the dump is on the same level as the stoking floor and the clinker is dropped over a vertical wall and is then loaded in carts and hauled to low undeveloped land a few hundred feet distant. While withdrawing the clinker, regulating valves are operated so as to shut off the air supply coming from the air heater.

One great advantage of the furnaces at this plant over the furnaces constructed at many other plants is that a deep fire is maintained, which enables the wet portion of the refuse to be more thoroly dried and destroyed than in shallow grates. In my opinion the success of this plant is partly due to this particular feature.

The average time of burning charge is 20 minutes. Usually six charges are made for each clinker produced on the grates. When the plant is working at its full or nearly full capacity the labor required is operated in three shifts of eight hours each. With the destruction of from 60 to 75 tons of garbage only one unit is used with three shifts of labor. This is better than to use two shifts, working both furnaces, for a more even supply of steam is delivered to the pumping station.

During July and August, when the delivery of watermelon rinds and other vegetable matter delivered to the plant averaged 20 tons daily, of course this amount of extra wet garbage, bringing the percentage of garbage above the guarantee, was only destroyed by adding dry material that had sufficient heat units in same to offset the excessive moisture in the garbage. This was brought about by adding about 10 per cent. in weight of cinders collected from manufacturing plants. With the addition of these cinders complete combustion of the garbage was obtained. The extra cost of the cinders was only the cost of drayage from the plants to the destructor plant.

From the day the plant commenced to consume the garbage on March 24, 1914, to the present date, all of the refuse delivered to the plant has been consumed and none had to be hauled away. The amount saved in fuel at the water works plant from March 23d to October 1st was a little over $3,000, or approximately $500

SAVANNAH DESTRUCTOR. *Stoking garbage on the furnace grates. Two units of four cells each, all shown in the photograph but cell No. 1 of the right-hand unit.*

SAVANNAH DESTRUCTOR. *Drawing clinker from grate into clinker car. Note greater easc of drawinig clinker by means of the apparatus providcd than removing by hand, as in earlicr furnaces.*

per month. Some changes have been made whereby there will be considerable increase in the amount of fuel saved and it is anticipated that from now on the saving will amount to about $600 per month. If the refuse delivered to the plant equals the capacity of the plant, sufficient steam will be furnished to operate the pumping station entirely and a saving of approximately $12,000 would ensue to the city.

The pumping station has two ten-million-gallon duplex compound Holly-Gaskill pumping engines and two cross-compound air compressors, all of which are operated condensing. The steam pressure carried at the water works plant is 90 pounds, but at the destructor plant is carried up to 150 pounds, with 100 degrees superheat. The pressure, however, is reduced by passing thru a reducing valve on the main steam header in the boiler room of the water works.

The total amount of refuse consumed from March 24, when the plant was completed, to September 30, was 14,364 tons. The cost of operating the plant was $8,190 and there should be added salary of weighman, amounting to $428, and a laborer at the pit supervising the dumping of the cars, amounting to $370, making a total cost for destroying the garbage of $8,988, or a cost per ton of 62¼ cents. Allowing for the saving of fuel at the pumping station for this period the net cost for destroying the refuse was 41.6 cents.

The percentage of clinker obtained from destroying the refuse varies from 20 to 30 per cent. of the total of refuse hurnt. During the season when the refuse is dry the weight of the clinkers is from 20 to 25 per cent. During July and August this varies from 25 to 30 per cent. It will be seen from the above that the unit cost of destroying the refuse was higher than the guaranteed cost, but it must be borne in mind that the guaranteed price is based upon the plant working at its full capacity, for then the amount of labor would be practically the same as when one-half of this amount was being consumed.

The cost of destroying the refuse, the amount of evaporation of water, and steam obtained is based on the refuse having the following percentages of material:

45 per cent. garbage.
40 per cent. rubbish.
10 per cent. ash or cinder.
5 per cent. manure by weight; the garbage to consist of organic material, vegetable and animal with water and grease; rubbish to consist of paper, rags, excelsior, straw, glass, etc.

Labor for each shift: One man to feed hoppers, four stokers, one engineer, one craneman and one man per watch, making total labor charges per watch $17.50, or $52,50 per day of twenty-four hours. This, however, is not expected to be adhered to, and with the amount of refuse to be destroyed less than 130 tons daily the cost of labor will be considerably reduced.

On June 4, 1914, a trial test lasting eight hours was made with a running start. The refuse was selected so as to comply with the specifications by which the contract is expected to be carried out. Sufficient steam was furnished to the water works during the twelve hours to operate entirely the plant, which would indicate a saving of coal at the rate of about $1,000 per month. The total refuse burned was 86,666 pounds. The actual duration of the test was 7 hours and 35 minutes, making the consumption somewhat above the guarantee. The total refuse burned per square foot of grate surface was 72.25 pounds, whereas the contractor's guarantee was 68 pounds. The average temperature of the combustion chamber during this test was 2,100 degrees, the guarantee being 1,500 degrees. The total water evaporated for compound refuse was 1.53 pounds, against 1.3 pounds, the guarantee. The estimated horse power in operating the plant was 118, the excess horse power being 452. The total number of charges made for both furnaces was 166. The number of times clinkers were drawn from both chambers was 26.

On June 25, 1914, a twenty-four-hour test was made, the actual duration of same being 23 hours and 15 minutes. The type of refuse destroyed was that guaranteed by the contractors to fulfill their contract. The total refuse per square foot of grate surface per pound was 69.94, above the requirements. The average temperature in combustion chamber was 1,862 degrees. The water evaporated per pound of refuse was 1.49 pounds; total boiler horse power developed per hour was 482. The horse power used in the plant was 118, giving an excess of 364, as against 330, the contractor's guarantee. The total number of charges of both furnaces was 440.

The final test was made on August 21-22. While the duration of the test was to be 24 hours, the amount of refuse delivered during this period, 138 tons, was destroyed in 21½ hours. The detailed data as regards this test are as per statement accompanying.

From the operation of the plant and from the test made, the opinion of the writer is that Savannah has a high temperature incinerating plant capable of destroying without difficulty 130 tons refuse per day, of furnishing by-product steam of an amount that will result in a saving of at least from $6,000 to $7,000 per year with the refuse now delivered to the plant. The plant has now been in operation for six months. No defects have been noted and no changes of any moment have been made since the plant was first put in operation. The city is destroying this garbage in a sanitary manner. It has been noted during the summer that the fly trouble has been very much less than in years past, and by some this is thought to be due to the elimination of the dumping of the refuse near the city.

I highly recommend to moderate size cities the destroying of garbage in the same manner as Savannah is destroying hers. With cities of large populations and where the percentage of grease is greater than 3 per cent. in weight of the true kitchen waste, the method of destroying garbage by the reduction process may be favorably considered.

Results of Test of Heenan Destructor at Savannah, Ga., August 21-22, 1914.

Duration of Test—From 3 a. m. August 21 to 12:30 a. m. August 22, 21½ hours.

Type of Refuse—Garbage, 45 per cent.; rubbish, 40 per cent.; manure, 5 per cent.; ash, 10 per cent.

Type of Destructor—Two 4-trough grate furnaces with forced draft.

Number of Furnaces at Work—Two.

Total Grate Surface—160 square feet.

Type of Boilers—Wickes' vertical water-tube equipped with Foster superheaters.

Total Heating Surface of Each Boiler—2,000 square feet.

Total Refuse Burned—277,550 pounds.

Total Refuse Burned per Hour—12,909 pounds; builder's guarantee, 10,833 pounds.

Total Refuse Burned per Square Foot Grate Surface per Hour—80.6 pounds; builder's guarantee, 68 pounds.

Total Clinker and Ash (approximate)—68,608 pounds.

Percentage of Clinker and Ash Obtained from Refuse Burned—24.7 per cent.

Maximum Combustion Chamber temperature—2,000 degrees F.

Minimum Combustion Chamber Temperature—1,700 degrees F.; builder's guarantee, 1,250 degrees F.

Average Combustion Chamber Temperature—1,845 degrees F.; builder's guarantee, 1,500 degrees F.

Average Steam Pressure (Gage)—120 pounds.

Average Temperature of Steam—523 degrees F.

Average Superheat—173 degrees F.; builder's guarantee, 100 degrees F.

Average Temperature of Feed Water—206 degrees F.

Total Water Fed to Boiler—397,162 pounds.

Total Water Evaporated from and at 212 degrees F.—450,382 pounds.

Total Water Evaporated per Pound of Refuse—1.62 pounds; builder's guarantee, 1.3 pounds.

Water Evaporated per Pound of Combustible—2.15 pounds.

Total b.h.p. developed per hour—607 pounds.

Estimated Horse Power Used in Plant for 75 k.w. Non-condensing Turbo Generator Set and Boiler Feed Pump—118.

Excess b.h.p.—489; builder's guarantee, 330.

Average Air Pressure under Grate—3¼ inches.

Average Air Temperature—252 degrees F.

Average Stack Draft—.72 inch.

Average CO_2—11.43 per cent.

Total Number Charges, both Furnaces—447.

Average Weight of Charge—621 pounds.

Total Number Clinkers Drawn, both Furnaces—64.

Cost of Operation—Based on Contract.

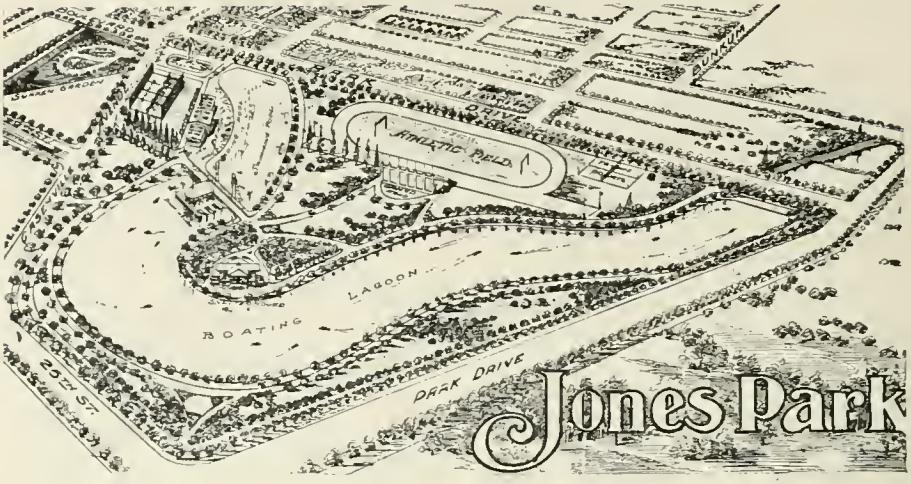
Hoisting—One man per shift of 8 hours @ $2.40	$2.40
Stoking—Four men per shift of 8 hours @ $2.40	9.60
Clinker Removing—One man per shift of 8 hours @ $1.50	1.50
Engineer—One engineer of 8 hours @ $4.00	4.00
Total labor charges per shift	$17.50
Total labor charges per day of 24 hours	52.50
Total labor charges per ton @ 130-ton rate	.404

Cost of Operation—Based on Actual Cost.

Hoisting—One man per shift of 8 hours @ $2.25	$2.25
Stoking—Four men per shift of 8 hours at $1.75	7.00
Clinker Removing—One man per shift of 8 hours @ $1.40	1.50
Engineer—One engineer @ $4.00	4.00
Total labor charge per shift	$14.75
Total labor charge per day of 24 hours	44.25
Total labor charge per ton @ 130-ton rate	.3403
Total labor charge per ton for 138.75 tons in 21½ hours	.318

Tests made with running start. All hoppers empty, and then charged with test mixture. On completion of test, hoppers were empty. All combustion chamber temperatures taken with thermo-electric recording pyrometer. All other temperatures were taken with mercury thermometers. Water measured with a Worthington hot-water meter. Steam pressures taken with a recording pressure gage connected to main steam line. Steam delivered to main header at water works and used to operate one 10,000,000-gallon pumping engine and one 1,850-cubic-foot cross-compound condensing air compressor. From 12:15 to 5:10 p. m. air compressor was operated non-condensing. From 6:30 to 10:30 p. m., 10,000,000-gallon pump speeded up. Steam from plant also used to operate all prime motive units for generation of power for use in plant. At 7 a. m. August 22, all refuse in storage pit was burned, and from then until 8 a. m., insufficient refuse was delivered to keep the plant going at capacity.

Weather during the test was hot and humid, with occasional showers. Test was started at 3 a. m. of 21st and completed 12:30 a. m. of 22d. All calculations based on A. S. M. E. standards. Safety valves of boilers were popping off from 5:30 p. m. until 6:30 p. m.



A PLAYGROUND FOR A SMALL CITY

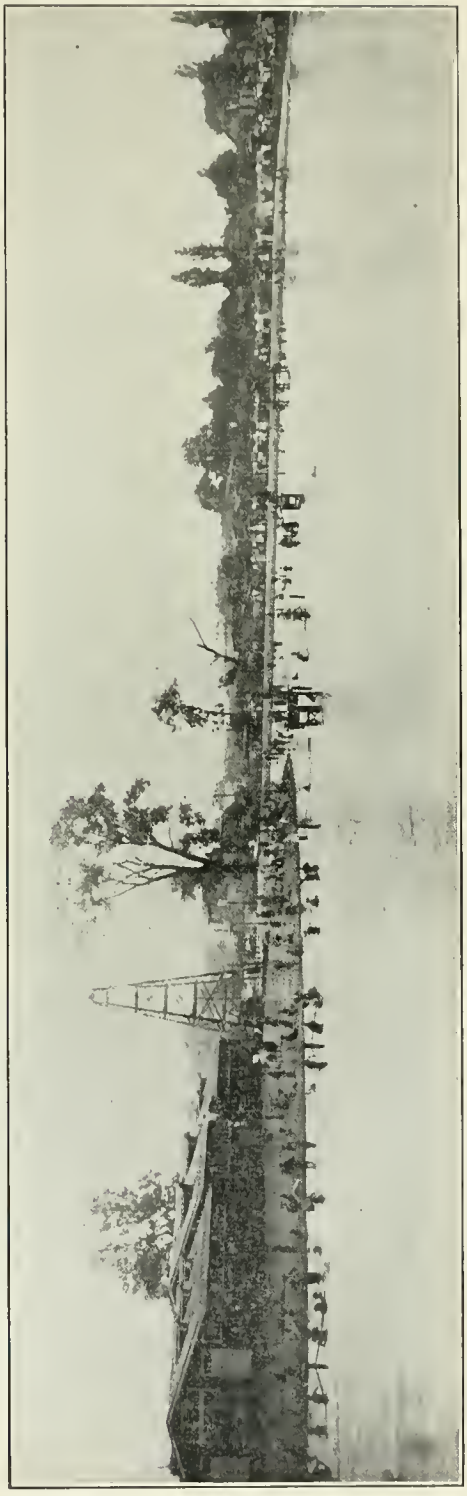
By Warfield Webb, Chicago, Ill.

This park shows the possibilities in a Mississippi river bayou in flat bottom land and is a striking example of what energy and ingenuity can do when directed by public spirit and a strong desire to meet a public need.

ONE of the most successful methods of combating the evils of congested life in our large cities has been the adoption of the playground idea by the municipalities, working thru the regularly established park boards. These organized bodies have been given funds wherewith to establish these breathing spaces, and the results in many cities have been such as to foster a far greater good by keeping the children, and the grown-ups, too, in some instances, from the evils of and dangers found in the streets. These nature nooks, placed in the heart of the very thickly populated districts, have been the one saving grace, and have acted as refuges wherein many a child has been protected from outside influences that are sure to make of the adult a citizen that is many times undesirable, to say the least.

Chicago has taken the lead in this respect, but there are other cities which have profited by the example, and have even gone a step further toward the ideal that will eventually predominate in many sections. The playground itself is of small value to the residents unless there are amusement devices, so that the hours spent in this retreat can be made more enjoyable, and at the same time prove a real source of physical well being to the visitors. These have been multiplied in number and character from time to time in some cities, and the newer and most modern of these smaller parks are models of service to the housed-in population.

Perhaps the most pretentious of these parks was opened several months ago at East St. Louis, Ill., and was given the name of Jones Park. This park comprises a tract of 46½ acres, and has been laid



THE SWIMMING POOL *in Jones Park, East St. Louis, Ill., with the bath-houses and dressing rooms on the left.*

out with the sole idea of making it a pleasure resort for the residents and visitors of the city. It has a natural forest growth and a very attractive scenic effect, but to this have been added many features, making the total cost of the same $75,000, including the purchase price of the ground.

The city of East St. Louis established a park board a few years ago, and, like other boards of this kind, it was given the power to construct boulevards, parks and kindred work. Since its inauguration there have been established several small parks in the city, but this latest and deservedly praised public playground ranks with any other in the country. To make this possible no expense was spared, and the object, that of placing at the disposal of the people a park of more than commonplace charm, has been realized.

The main features of this park are, a large open-air swimming pool, lagoon, grand stand and rest house. The lagoon, which covers about seventeen acres, is 200 feet wide and a half mile in length. Overhanging willows add to the natural charms of this boating and canoeing resort. The greatest depth in any place does not exceed four feet, thus insuring a safe depth and still permitting the easy movement of the boats. At one end of the lagoon a large and attractive boat house has been erected, and ample space has been permitted for the docking of the boats.

One other feature that attracts much favorable comment is the open-air swimming and bathing pool, which cost $7,000. In connection with it is a bath house, 165 feet in length by 36 feet in width. This will accommodate 376 men and boys and 190 women and girls. The cost of this structure was $8,000. Directly in front of the bath house is a 3-acre sand beach, making it possible to enjoy the delights of the seashore at home. The depth of the water has been regulated so as to make it perfectly safe. The shallow sec-

tion varies from six inches to four feet, and covers about 78,000 square feet. The deep water section is 450 feet long by 120 feet wide, and reaches a depth of eight feet. This has been provided with diving platforms and spring boards, offering every facility for aquatic sports. There are 4,678,500 gallons of water in the entire pool. To insure the sanitary qualities of the water at all times, there is an influx of 800 gallons per minute supplied from a well located adjacent to the pool. Water polo and swimming races are to be a part of the regular pastime in this pool.

The most notable feature of the park is the concrete grandstand, erected at a cost of $10,000, and having a seating capacity of 1,000 persons. This grandstand faces a quarter-mile track, the latter being twenty-five feet in width and having a 200-yard straight-away. The space directly in front of the grandstand is given over to baseball, football and kindred sports. Directly beneath the grandstand the space has been given over to lockers and shower baths, to be used by both men and women who participate in the games.

Other sections of the park, comprising seven acres, are given to tennis courts. Then there is the regular playground for the children, all ages being deemed children here. Here are found swings, sand piles, croquet grounds, courts for horse shoes, quoits, toboggan slides and other sports that delight the visitor.

The rest house, an essential of park equipment, is two stories in height and is constructed of a pleasing pattern of fire brick. It cost $17,000. On the lower floor are found sanitary drinking fountains, comfort stations for both sexes and a hallway, and on the upper floor a covered pavilion that overlooks a dense grove. Easy chairs and settees are here in abundance, and a space for band concerts. This section has been particularly assigned for the meeting of social organizations that will find it a place of pleasure and restfulness. It is also intended to be a haven for mothers, who may come here and rest and still enjoy the delights of the park.

The natural beauty of the park was not materially damaged by the erection of the buildings, but other trees have been planted, and these will in a few years add their charm to the place. All wires are underground, and the walks are of concrete. Other facilities such as drinking fountains, settees, waste baskets and every convenience, have made this park one of the finest examples to be found today in any city.

THE SHELTER HOUSE *in Jones Park, East St. Louis, Ill. The foreground shows that the patrons of the park have not yet learned their part in keeping a park beautiful by keeping their litter off the grass.*

EXPERIMENTAL PLANT FOR TREATING SEWAGE

AT BROOKLYN, N. Y.

By George T. Hammond, Engineer in Charge.

The plant for making experiments on the treatment of the sewage of Brooklyn, N. Y., has not been in operation long enough to warrant the publication of definite statements of the results of its operation, but the general observations of its action are so satisfactory that this description of its general features is warranted and will be of value to other cities considering the installation of experimental plants. The article is abstracted from a paper before the American Society of Municipal Improvements, which goes into greater detail of measurements. The accompanying photographs will illustrate the description.

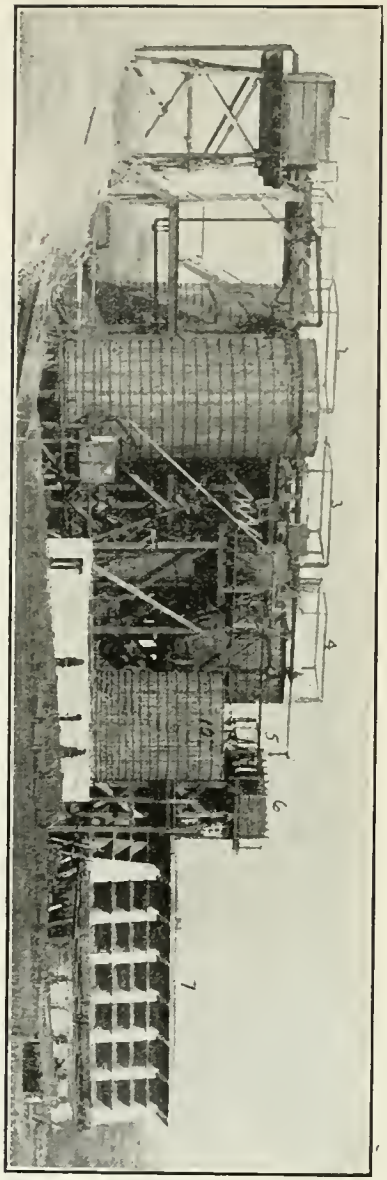
THE object of this paper is to present a brief description of an experimental plant for sewage disposal investigations recently designed and installed by the Bureau of Sewers, Brooklyn, N. Y. This plant was designed and constructed in response to a resolution of the Board of Estimate and Apportionment, of the city of New York, which authorized, for the purpose of constructing the plant and carrying on the experiments, the sum of $50,000.

The experimental plant is located in close relation to the existing New Lots, or Twenty-sixth Ward, sewage disposal plant, and obtains its sewage from the main sewer, which serves the Twenty-sixth Ward district of Brooklyn. The sewerage system, for which this sewer is the outfall main, serves a population of about 200,000, occupying an area of approximately 5,000 acres. The sewers are on the combined plan and have rather flat grades. The disposal plant is about two miles from the center of population and the sewage becomes septic, during the warm months of the summer, before reaching the outlet. A new disposal plant is urgently needed for this district, and has been authorized, the design to await the results of experimental study to determine the most suitable method of treatment for local conditions.

The experimental plant consists of three Imhoff tanks, each of different depth but with other dimensions equal; six sprinkling filters, two of which receive forced aeration within the mass of the medium; various tanks and apparatus for the investigation of sewage treatment by forced aeration; secondary settling tanks for the sprinkling filters and the sewage treated by forced aeration; a plain settling tank for crude sewage in connection with an airtight sludge digestion tank, which receives settled matters and sludge from the plain tank, being in effect the two essential portions of an Imhoff tank separated; a roughing filter; ten sludge drying beds; various experiments for screening sewage, and for drying sludge, including a fixed mesh screen, a rotary disc type screen, and a canvas vacuum filtration system; various provisions for disinfection experiments, etc.

The mechanical plant consists of steam-actuated sewage pumps and an air compressor.

The twin sewers pass, at the location of the existing disposal plant, thru a silt



VIEW of Brooklyn sewage experimental plant from the south.

1. *Quieting tank into which pumps discharge and from which sewage flows with determined constant head to treatment tanks.*
2, 3, 4. *Imhoff tanks Nos. 1, 2 and 3, partly hidden by other structures.*
5. *Roughing filter at end of dosing tanks.*
6. *Dosing tanks.*
7. *Sprinkling filter bed before construction of wind shield around tops of beds.*
8. *Aerating tank.*
9. *Aerating siphon.*
10. *Sprinkling filters with forced aeration. At their base settling tanks and sludge drying beds.*
11. *Secondary settling tanks below the sprinkling filters* (7).

basin which, in dry weather, acts as a grit chamber for the sanitary sewage. This basin, which is covered with a masonry roof carried on I-beams and piers, is 80 feet by 60 feet in interior dimensions, and 9 feet deep.

The pumps that furnish the sewage for the experiments are located within the existing disposal plant building, and steam is obtained from the boilers of the plant. There are two sewage pumps, both of them direct acting piston pumps, installed so that either pump may be cut out and cleaned or repaired without stopping the other, with capacity of 1,200,000 and 650,000 gallons a day. Provision is made for placing a movable screen around the lower end of the common 12-inch suction pipe thru which both pumps operate, which is cleaned by means of a water jet and brush.

The sewage for experiments is discharged from the pumps thru an 8-inch iron pipe into the quieting tank, which supplies sewage to the various units of the experimental plant by gravity.

As the experiments include an extensive study of sewage aeration by means of compressed air, an air compressor is installed with a displacement capacity of 228 cubic feet of air per minute at not exceeding 210 r.p.m. for 30 pounds air pressure, with 100 pounds of steam at the throttle. The air passes from the compressor to an air receiver, of steel, 24 inches in diameter and 72 inches high, with pressure gage and safety valve.

The low elevation of the ground, a tidal marsh, requires the plant to be above the reach of the highest tide, and pumping of the sewage to a level from which a gravity flow could be obtained for every unit of the plant.

Every unit was provided with a measuring device for the determination of the quantity of flow, usually consisting of an

adjustable calibrated orifice above which a constant head is maintained by a system of overflow weirs.

For measuring compressed air, venturi meters were provided.

The above-ground construction of the plant affords opportunity for studying the flow of sludges of different kinds, Imhoff especially. The effect of cold weather on exposed sprinkling filter beds, and the danger of freezing of the various channels carrying sewage, and the proper method of protecting and operating the same, are incidental studies of great importance in view of the projected construction of a plant on piles over an extensive marshland.

Early in the studies which preceded the design of the experimental plant it was of importance to ascertain the quantity of sewage flow per day and per capita from the drainage and sewer district, the entire flow passing into Jamaica Bay at this point through the main sewer, as already described. This was done by means of a knife-edge weir 26.83 feet long, with end contractions suppressed, installed in the open outfall trunk sewer.

The quieting tank stills the flow coming from the pump, and supplies a regulated supply of sewage to every part of the plant, maintaining a constant head in the supply at an elevation of 33.42. This tank is rectangular in shape, 5 feet in depth, and 12 feet 3 inches by 8 feet 10 inches in plan. In its interior each end is divided off by a partition, forming overflow chambers, which are connected with the waste pipe; the main chamber is between these internal partitions and is 9 feet in length by 8 feet in width. Each partition is cut down to the waterline a distance of 3 feet from the outlet side of the tank, forming overflow weirs designed to maintain a constant head over the outlet orifices. Two baffles are placed lengthwise of the tank, between the above mentioned partitions and normal to the line of flow. The baffle nearest to the entrance of the sewage extends 3 feet upward from the bottom, and is 2 feet 6 inches from the entrance side of the tank. The other baffle extends downward, from the top of the tank, to within 1 foot of the bottom, and is 2 feet 6 inches from the first baffle, parallel with it, toward the outlet side.

In the side of the main chamber of the tank, opposite to the entrance of the sewage, are placed six outlets, each provided with an adjustable orifice having a calibrated scale, which may be set to any rate of discharge within its range of capacity. These orifices discharge into flumes that lead to the various experimental units, each orifice into a flume which it serves. The means of maintaining a constant head is, in all cases, an overflow weir, over which a surplus flow is kept wasting to a

AERATING TANK, *showing surface of sewage under aeration. Either raw sewage or effluent from Imhoff tank can be aerated as desired.*

IMHOFF TANK *with deck removed. Note a slight scum has formed, after one week without disturbance, on which algae are growing. No sulphuretted hydrogen smell at any time.*

lower level, where it may be used, if required, for other experiments or led back to the main sewer.

The Imhoff tanks, three in number, differ only in depth, each being provided with a sedimentation chamber with the depth proportionate to the depth of the tank in which it is placed, so that the effect of depth (other conditions being equal) may be observed in the comparative performance of the tanks.

The scum boards, placed 12 inches from and opposite the entrances and exits of the tanks, are in all cases 2 feet in depth, and no other baffling is provided for in the first series of experiments. The dimensions of the horizontal section of each sedimentation chamber, at the lower edge of the scum boards, are equal in every particular in all the tanks; and the entrance and exit weirs are of identical design and diniensions. When the experiments upon the comparative effect of depth in sedimentation chamber, and sludge digestion chamber, have been completed, baffling will he provided in connection with experiments upon rates of sedimentation at various rates of flow. The sedimentation chamber of either of the tanks can he temporarily removed and a rearrangement made for Dortmund tank experiments. Connections can be made so that the whole three can he operated in series, either as Imhoff tanks or as Dortmund tanks, by a few inexpensive changes. Each tank is 15 feet in internal diameter. The inlet and outlet of each tank is made of galvanized iron, forming a distributing or a collecting chamber, as the case may be, in front of the entrance weir, or outside of the exit weir, which weirs are both full width of the sedimentation chamber; the aim being to distribute the flow uniformly, and to take off the effluent in the same manner.

The sedimentation chambers are of pine, easily removed and reconstructed. The sloping floors, which are of 2-inch pine, planed smooth, were placed first, after which the vertical sides were put in place, which are of 1¼-inch pine, planed smooth, their lower ends resting upon the sloping bottom planks, so as to eliminate a vertical joint. These vertical walls are 10 feet 8 inches between sides and a maximum of 2 feet between these and the outer shell. The sides and sloping floor are of tongued and grooved boards, carefully matched and smoothed inside. The spaces between the vertical walls and outer shell serve as gas outlets for the digestion chamber.

In making the openings from the sedimentation chamber for the passage of settlings into the digestion chamber, the inclined floors do not lap or pass, the one

in such tanks, the intention being to study the form of opening by changing it, perhaps several times; the form at present installed having been considered the most troublesome to try out was selected for the first trial. There is some reason to think that this form of opening is less liable to become clogged than the form ordinarily used, and in six months' service it has worked so well that no collection of settlings has at any time remained upon the slopes. The opening is guarded by means of a timber shield or baffle board placed below it with its upper slopes the same as the bottom slopes of the sedimentation chambers, thru which the sludge pipe passes at the center of the tank, care having been taken to make the pipe passages gas tight thru the wood. The sludge pipe in each tank is 8-inch iron pipe with a flange at the top, provided with a cover, and is carried by two 6-inch by 8-inch yellow pine timbers crossing the top of the tank; the pipe is suspended from iron channels crossing from timber to timber and placed under the flange at the top. The sludge pipe is provided with a branch pipe for drawing sludge, which passes thru the side wall of the tank, having a gate valve and being connected with the sludge outfall channel into which it discharges.

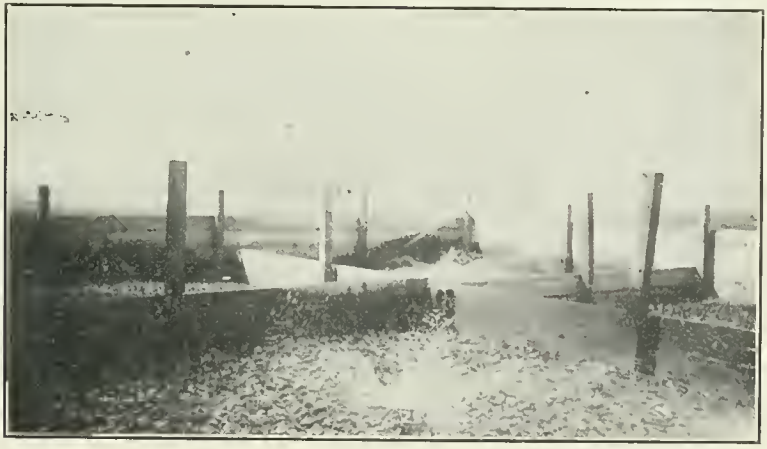
The bottom of each digestion chamber is formed inside of the cylindrical tank, in the shape of an inverted truncated hexagonal pyramid, made in two sections, the upper overlapping the lower. A perforated lead pipe, 1¼ inches in diameter, connected with the city water suply, and controlled by a gate valve, is placed entirely around the tank, under the overhanging edge of the upper pyramid, for use to start the sludge sliding down the slopes, if necessary, and for cleaning the slopes.

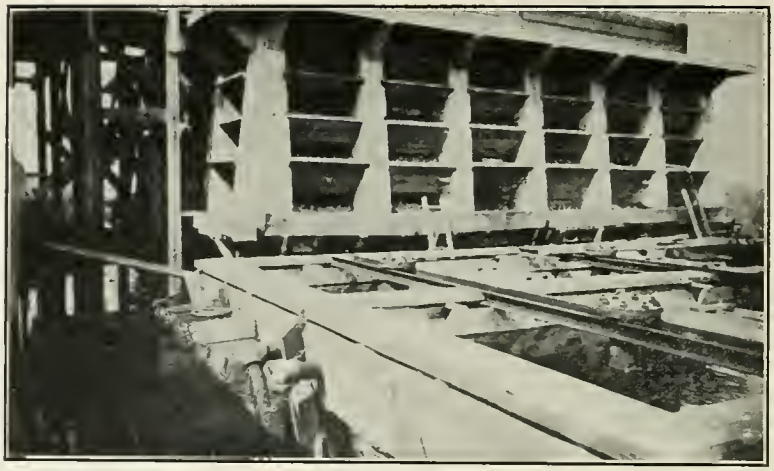
The effluent from the tanks may be distributed by gravity from the outlets to all the experimental units where its use is required. Provision is made to return surplus to the main sewer by waste pipes of iron, 4 inches in diameter, which are led down the sides of the tank, affording branch connections, provided with gate valves, for tapping the tank at lower points. Thus it is possible to entirely discharge the contents of the sedimentation chamber without disturbing the sludge digestion chamber. It is also possible to obtain samples of sludge from the bottom of the tank without the disturbance that would be caused by drawing thru the 8-inch sludge pipe, or to discharge the entire contents, when repairs or alterations are required.

The tanks are covered on top, except for the opening over the inlet and outlet weirs, with movable floors, made of 2-inch pine plank, in sections, with lifting rings for handling.

The Imhoff tanks differ only in vertical

SPRINKLING FILTERS, *two in operation, with wind breaks to prevent irregular action.*





SPRINKLING FILTERS *as seen from the sides. Tops of secondary settling tanks are in the foreground.*

dimensions and cubic capacity, as follows, the depths being given inside from the water line downward:

	Depth of Tank at Center, Feet.	Depth of Sedimentation Chamber— Vertical Center.	Side.
Tank No. 1....	30.38	9.22	13.97
Tank No. 2....	21.88	5.30	10.05
Tank No. 3....	13.67	2.42	7.00

Changes in the sloping bottoms, of sedimentation and sludge digestion chambers, are easily possible; also in design and width of the opening between the upper and lower chambers. The slopes were provided to begin with as flat as was thought safe, but so far they have not retained any sediment and probably might have been flatter without causing trouble. These tanks have been operated since October 4, 1913. Probably the smooth timber surface affords less friction to the sliding of settled matter than would concrete. It is intended to cover the slopes with a concrete surface, before the completion of the experiments, to investigate this question.

The effluent from the Imhoff tanks flows by gravity to the following units, all of which may be simultaneously in action:

1. The sprinkling filters and roughing filter.
2. The aerating tank.
3. The aerating siphon.
4. The sprinkling filters with compressed air aeration.
5. To a secondary settling tank.
6. To disinfection tanks.
7. To mechanical vacuum filter tanks of the Moore pattern.

Sludge for testing and drying is discharged to the Imhoff drying beds; the surplus sludge is washed into the main outfall sewer.

Plain sedimentation experiments are provided for in a tank of the Dortmund type, which is one of a group of four tanks, each of the same size and design, constructed of concrete, 8 feet by 8 feet in interior plan and 8 feet deep from the water line in the center, the bottom being designed of pyramidal form. The other three of these tanks are used as secondary settling tanks for observing the effluents of the aerating siphon, aerating tank and the Imhoff tank. The flow, entering, is carried down under the center of the tank and, rising, is taken off thru V-shaped notches, of which two are provided on each side, into wooden troughs which completely surround the top of each tank. A 6-inch sludge discharge pipe is placed in the center, terminating with a bell at the bottom and provided with a

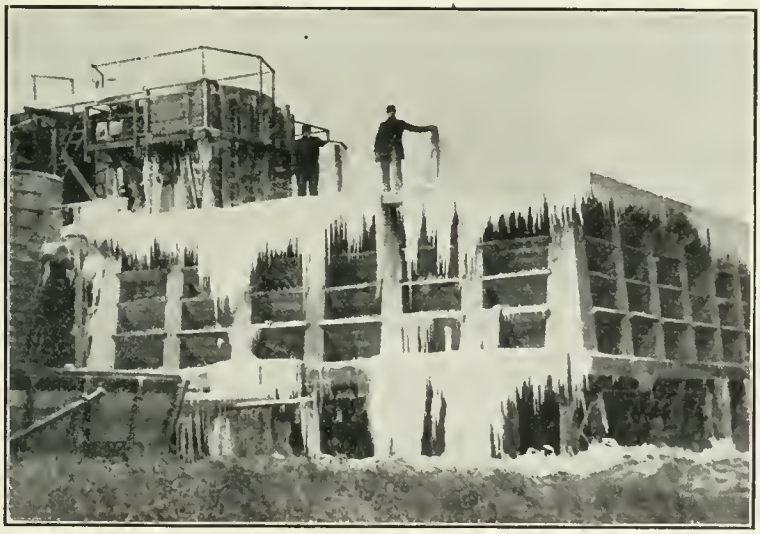
clean-out at the top of the vertical portion above the water surface. Sludge is discharged thru a horizontal branch, passing thru the tank wall below the water line, into a flume that carries it to the sludge beds. The tank selected for raw sewage sedimentation has, in addition, a sludge discharge pipe branching from the pipe described above, which passes to a sludge digestion tank especially provided for the purpose of experimenting with sludge taken from raw sewage.

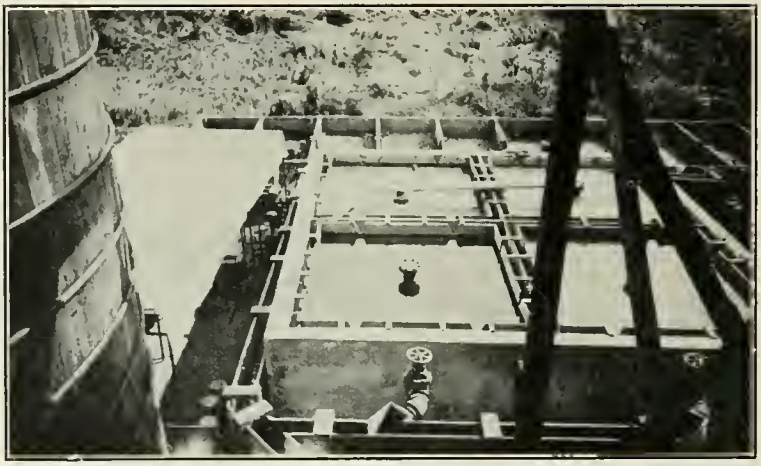
The sludge digestion tank is of steel, made to be air and water tight. It is 5 feet in diameter and 15 feet in depth, with a pyramidal bottom, set vertically in the ground so that no part of it shall be above the water line of the plain sedimentation tank from which it receives sludge. The effect of varying temperature or of chilling from ground water is minimized by a double shell with an air space between shells. In operating the tank sludge is drawn from the settling tank under water pressure due to the head of water in the tank, by means of a branch in the sludge pipe, and passes thru the sludge inspection box after opening the valve into the digestion tank. The sludge remains in the digestion tank until it is digested. Before any sludge enters it is necessary to let out enough of the water from the top of the tank to furnish sufficient difference of head for the sludge to flow in. The digested sludge is discharged upon the Imhoff drying beds by means of the sludge pipe in the same manner as from an Imhoff tank.

Direct aeration experiments may be carried out with raw sewage supplied from the quieting tank, or with the effluent of the Imhoff tanks. The principal direct aeration experiments provided for are to be carried out by means of an aerating siphon, and an aerating tank. Experiments will also be made with sprinkling filters supplied with compressed air thru a grid placed within the mass of medium.

The siphon aerator may be operated with raw sewage or Imhoff effluent. The flow of sewage is led, by gravity, to the bell at the top of the siphon down-take pipe, into which the sewage falls, entraining or sucking the air in with it, and passing vertically downward thru the pipe with considerable velocity, the entrained air becoming compressed. It is claimed by the patentee that the sewage exposed to air under pressure absorbs a greater portion in consequence of the pressure, as the volume of air absorbed will be in pro-

SPRINKLING FILTER *beds and dosing tanks at five degrees below zero continued in full operation. Wind breaks not in place on the surface.*





SECONDARY SETTLING TANKS *in the foreground and sludge drying beds in the small boxes immediately in their rear.*

portion to the pressure. The apparatus consists of a 4-inch pipe extending vertically downward, 130 feet from the bell at the top; first thru the center of a vertical tank 30 feet deep and 4 feet in internal diameter, and, second, from the bottom of the tank thru an 8-inch pipe, leaving an annular space thru which the sewage can flow upward from the bottom of the 4-inch pipe into the vertical tank, in which it is retained for a period of time in proportion to the quantity of flow and capacity of the tank. The effluent is discharged from the top of the vertical tank by means of a waste pipe and a measuring orifice box from which a portion of the flow is led, for observation, to the settling tank.

The tank aerator is for the purpose of experimenting, both upon crude sewage and Imhoff tank effluent, with forced aeration, either by fill and draw or constant control. It is a tank 12 feet in diameter and 25 feet 8 inches in height. The sewage enters at the top of the tank by gravity at eight points from the quieting tank or the Imhoff tank outlets. The sewage may fill the tank so that these points of entrance are submerged, or the tank may be operated at lesser depths of contents. The sewage or effluent of the tank is taken off at the bottom by means of four 3-inch openings into a 5-inch pipe.

A grid for supplying compressed air is placed at the bottom of the tank, upon 7½ inches of broken stone, the same depth of broken stone being placed over it. The grid consists of 1½-inch pipe at right angles, forming a cross, connected in the center, the arms of the cross being connected with quarter-circles of ¾-inch pipe forming concentric rings, of which there are five; each ring being perforated at 6-inch intervals with 1/16-inch holes. The air enters thru the 1½-inch pipes and is distributed thereby to the rings, and is discharged into the broken stone surrounding the grid, which tends to break up any upward stream effect.

The main outlet for the tank effluent is 1 foot above this grid.

Thru the central axis of the tank is placed a vertical 4-inch pipe which serves to center and support the deflector discs, of which there are nine, provided for the purpose of deflecting the downward flow of sewage and upward flow of air bubbles, so as to obtain even distribution of both air and sewage.

The deflectors are designed in the form of a wheel with a hub which is of iron; six radial arms are provided between which slats are placed, running from arm to arm, the slats being set in grooves in the arms and at an angle of about 45 degrees with the horizon, the slats in each alternate deflector being set at angles alternating from and toward the center in order to give the sewage a sinuous motion in passing downward.

There are six percolating or sprinkling filter beds, all of them supplied with sewage by means of dosing tanks, and the sewage applied may be

(1) crude from the quieting tank;

(2) aerated sewage effluent from the siphon aerator;

(3) aerated sewage effluent from the aerating tank;

(4) settled sewage from the Imhoff tanks;

(5) any of the foregoing passed thru a gravel roughing filter;

(6) effluent from fine screens of the Reinsch-Wurl pattern (not yet installed).

The sewage flows by gravity to the dosing tanks, except the fine screen effluent which requires pumping.

Each dosing tank is provided with a 5-inch Miller siphon which discharges the dose into the inverted pyramidal feeding tank from the bottom of which it is carried by a pipe embedded in the medium to the sprinkling nozzle, by which it is sprayed over the bed. The gravel roughing filter is so arranged that sewage, on its way to the dosing tanks, may be passed thru it; the medium provided is gravel passing a ¾-inch ring and retained on a ½-inch ring. The gravel is 12 inches deep, supported in the middle third of a wooden tank by means of a wire screen of ¼-inch mesh. Such a filter has been found very effective by Mr. Watson at Birmingham for protecting the spraying nozzles. It is very effective as a remover of hairs and small particles that have escaped the settling tank. The roughing filter may be used or by-passed at will.

The sprinkling filters, served by a single group of dosing tanks, are divided into two groups, the first of four filter beds of the ordinary type; the second of a tank 12 feet in diameter and 16 feet high, in which are placed separated two beds, each side filled with stone filtering medium to the same depth, and each is underdrained with 6-inch half-pipe tile on a concrete bed, draining independently to a secondary tank, and is closed from external air by the tank walls, separate from the other. Each side is provided with a grid, for supplying compressed air, placed within the medium near the bottom of the beds, formed of ¾-inch iron pipe perforated every 6 inches with ⅛-inch holes, thru which the compressed air is supplied. In operation, the sewage is sprayed upon the surface of the beds by a single nozzle placed at the center of the two beds, over the dividing wall between them. Both beds may be operated as ordinary sprinkling or percolating filter beds, in which case air is carried into the bed from the surface only. Compressed air may be supplied to both sides at the same time, or one side may be operating as an ordinary sprinkling filter, while the other is operated as a sprinkling filter with compressed air added in the bed, in order that the effluents may be compared and the effect of the added air be observed.

The filtering medium in both sides is best selected trap, broken to pass a ring 2½ inches and be retained by a ring 1¼ inches in diameter. The depth of the medium is 10 feet, which may be increased to 14 feet by adding to the surface and raising the nozzle.

Size of Medium in Filter Beds.

Bed No. 1, stone passing ring 1½ inches in diameter, retained by ¾-inch ring.

Bed No. 2, stone passing ring 2 inches in diameter, retained by 1-inch ring.

Bed No. 3, stone passing ring 2½ inches in diameter, retained by 1¼-inch ring.

Bed No. 5, stone passing ring 2½ inches in diameter, retained by 1¼-inch ring.

Bed No. 6, stone passing ring 2½ inches in diameter, retained by 1¼-inch ring.

Bed No. 4, stone passing ring 2½ inches in diameter, retained by 1¾-inch ring.

In order that the effect of the depth of filter medium under similar conditions of operation may be obtained, test trays with outlet pipes are placed in the filter beds at different depths. The trays are V-shaped, 10 inches wide, and extend from the wall to the center of each bed. Each is provided with a drain pipe with a stopper, used when samples are being obtained. The trays are so placed that samples may be taken at depths from the surface of the bed of 6 feet, 7 feet 3 inches, and 8 feet 6 inches. Samples taken from the bottom of the bed give the result of 10 feet depth. Thus samples from four different depths of medium are available for observation from each bed.

In order to prevent the effects of wind

on the sewage distribution, a shield is provided, consisting of a board fence at the surface carried between the beds and around them.

The secondary settling tanks to which these filters discharge are placed in a group. Each tank is an inverted truncated pyramid, 10 feet deep from the water line. The flow enters thru a 2-inch pipe down to a point 2 feet above the bottom. Settlings are removed by the hydraulic head of the tank. The tank effluent is taken off by troughs passing entirely around the top of each tank thru V-shaped notches.

For the purpose of testing the character of sludges from the different experimental units, and making observations on rates of drying, sludge drying beds of the Imhoff type are provided. There are 10 beds, each 5 feet wide by 12 feet long, constructed upon a timber platform, each bed supplied with a 6-inch half-tile pipe underdrain, placed along the center from near the inlet to the lower end of the bed. The medium consists of 8 inches of steam ashes surfaced with 1 inch of coarse sand. Timber partitions separate the beds, each bed being in effect a tank into which the sludge is discharged by means of sluices controlled by gates. Sludges can reach these beds by gravity from all of the sludge producing units of the plant.

Disinfection investigations will be undertaken when the various units of the plant have been given sufficient time to develop the best possible effluents, and the Reinsch-Wurl screens, and vacuum filters are in operation. Tanks are provided for the purpose.

The experimental plant was, for the most part, completed in December of last year and put into regular service January 1st of this year. Sufficient time has not yet elapsed to make any results available for publication. The service of the sprinkling filters, during the zero weather of last winter, was accompanied with the formation of considerable ice.

The portions of the plant not yet completed include the major portion of the screening apparatus of which two Reinsch-Wurl screens are intended to constitute an Important part.

A Thriving Argentine City.

As an example of the rapid development of cities in the Argentine Republic, Tucuman may serve. It is located in the northern section of the country near the foot of the Andes mountain range, some 24 hours by train from Buenos Aires and 18 from Rosario. It has three railroads to the southeast and one to the north, the latter and one of the former being government lines. The present population of 88,202 in the city proper (95,970 in the urban district) increased 22 per cent. in four years and over 120 per cent. in twenty years. Houses are almost wholly one-story brick, most of them with modern improvements. Real estate brings high prices and still the rented returns are some 9 per cent.

The National Government constructed the water works and sewerage systems at a cost of $2,800,000, and they are managed by it, but will be gradually paid for and then taken over by the province. There are three private electric light and power companies, all now under the control of one of the railways. One of these companies operates the street car lines, of which there are 15.5 miles in operation, with 24 cars, transporting over three and a quarter million passengers a year. This plant is operated by steam. One of the plants utilizes water power from one of the numerous mountain streams of the province. American promoters were interested but the machinery used has been British or Swedish, "followed by German," with but little from the United States. This is but one indication of opportunities for the United States to follow with their machinery.

Electric light rates run from 10.6 cents per kilowatt for small consumers to 5.1 cents for large; power rates from 6.4 cents to 3.4 cents.

Manufacturing has not as yet developed, sugar and alcohol being the principal products, with builders a good third.

BITUMINOUS MACADAM ROADS
IN RHODE ISLAND

By Irving W. Patterson, Chief Engineer of Rhode Island State Board of Roads, Providence, R. I.

The state of Rhode Island laid a number of test sections of bituminous macadam road in 1909, using varying specifications. The chief engineer of the State Board made report upon these experiments at the Atlantic Road Congress, in a paper from which this article is taken. It also includes report upon other bituminous roads laid in the state since 1906.

THE first road built was remarkably successful and is now perfectly intact and presents a perfect mosaic appearance and has required no repairs in the eight years it has been in use.

Another road laid in 1907 was not so satisfactory, probably because the subsoil is less stable. No seal coat was used on either of these roads and the horse traffic is light.

In 1908 many materials and combinations were used with generally negative results, nearly all those differing from those used in 1906 and 1907 giving inferior service.

In 1909 a number of test sections were laid on the Nayatt Point road in the town of Barrington. The road has an average traffic in summer of 350 vehicles a day and less during the winter, largely motor vehicles, with considerable heavy horse-drawn traffic in early spring and late fall. The width of metal is 14 feet, with crown of ¾ inch per foot. No foundations or sub-drains were necessary. Crushed stone was laid to total compacted depth of 6 inches; first course 4 inches of 3 to 1½-inch stone and second course 2 inches of stone mixed by hand on a wooden mixing platform with bitumen of sizes and kinds named below. A 15-ton roller was used.

In experiment No. 1 Connecticut trap rock of commercial 1¼-inch stone, i. e., ½-inch to 1½-inch screen, and half each of crude tar and hard asphalt were used in the top mixture, 18 gallons of binder per cubic yard of stone. The seal coat on ½-inch screenings took ¾ gallon of asphalt per square yard of surface. Cost was $0.827 per square yard.

This section was very nearly a failure. Hair lines developed inside of one month after completion and by the following spring ravelling had become quite extensive. Patching has been necessary every year since construction. What remained of the original surface by October, 1914, appeared rough and hair-lined and numerous breaks were in evidence. The character of the stone employed in the mix was one reason for failure. The percentage of the smaller sizes of stone as compared with the percentage found in native stone was small in the commercial trap rock, so the rolled mixture consequently was far from compact. The combination of tar and asphalt in the mix is also a reason for failure. Such a combination has not given first-class results, altho with some grades of stone the results have been fair.

In experiment No. 2 native stone was used and the amount of binder was reduced to 15 gallons per cubic yard of stone. Otherwise construction was same as No. 1. Cost was $0.788 per square yard.

The results have proven fairly satis-

factory. There have been a few breaks in the surface which required repair. These breaks have occurred with increasing frequency since construction. The cost of maintenance during a period of five years was approximately $0.025 per square yard. Upon examination in October, 1914, the surface presented a smooth asphalt finish except in a very few spots where the seal-coat had worn off and allowed the surfaces of the stones to become visible. A sample of the road taken up, however, showed that there was no appreciable life left in the binder. The material in the seal-coat appeared to be in good condition. The superior success of this section as compared with No. 1 is attributed to the superior grading of the sizes of native stone, with the resulting stronger mechanical bond.

In experiment No. 3, the same construction as in No. 2 was used except that 16.5 gallons of refined coal tar were used per cubic yard, and ⅝ gallon of the same per square yard for seal coat. Cost was $0.838 per square yard.

The results to date have been very satisfactory, altho a complete renewal of the seal-coat is called for. No repairs to the metalled surface were carried out until the fall of 1914, altho the necessity for repair was evident for some time previous. The seal-coat began to disappear noticeably about one year after construction. Two years after construction a true mosaic surface was presented by the exposed surfaces of the crushed stone. The surface gradually became rougher, due apparently to the decomposition of the binder in the surface voids. Ravelling was not in evidence until the summer of 1914. The need for renewal of the seal-coat was felt in 1913, but since the section was experimental, was left to see exactly how long it would be before disintegration set in. Examination during October, 1914 (previous to any repairs being made), showed a rough mosaic surface with occasional evidence of ravelling. Abrasion of the stone by traffic was very evident, the surface being covered with a very light coating of particles of stone, which apparently had been broken off from the stones composing the road surface.

In experiment No. 4, 21 gallons of asphalt were used per cubic yard of stone and ⅝ gallon of asphalt per square yard for seal-coat. Cost was $0.898 per square yard.

The results obtained upon this section are to date superior to the results secured upon any other section. No repairs have been necessitated. Examination during October, 1914, showed a perfectly intact, smooth asphalt finish.

In experiment No. 5, 24 gallons per cubic yard of stone of a mixture of refined tar with 20 per cent. of asphalt was used as binder and the same in the seal coat, ⅝ gallon per square yard. Cost was $0.924 per square yard.

The results obtained upon this section are very fair. The surface became perfectly mosaic inside of two years from the date of construction, due to the disappearance of the seal-coat. No repairs have been given this section, but the need for a renewal of the seal-coat has been appreciated for two years. Inspection during October showed a rough mosaic surface, perfectly intact as far as ravelling is concerned, and slightly darker in color than the surface of section No. 3.

In experiment No. 6, the materials and amounts were the same except that 10 per cent. of asphalt was used in the binder. Cost was $0.917 per square yard.

The results obtained upon section No. 6 were not noticeably different from the results secured upon section No. 5. No repairs have been carried out upon this section to date. Observation during October, 1914, could disclose no differences in appearance or condition from section No. 5, except, perhaps, a slightly lighter color.

In experiment No. 7 refined tar was used in both binder and seal-coat, quantities same as in No. 6. A mixing machine was used, which was a special heated platform upon which mixing was accomplished by pulling by hand the crushed stone thru a reservoir of heated bituminous material. There was no saving in labor. Cost was $0.910 per square yard.

The results secured in this work are not appreciably different from the results described in the report of experiment No. 3, where also a refined tar was employed. Ravelling has not progressed

to the extent that it has upon No. 3, but examination showed evidences of ravelling.

In experiment No. 8 the machine was used and the same amount of refined water gas tar. Cost was $0.932 per square yard.

The results secured upon this section have been very satisfactory. One patch was necessitated about one year after completion, but no further repairs have been needed. The seal-coat has worn off, but decomposition of the binder has not extended down in the surface voids appreciably. Examination during October, 1914, showed a smooth mosaic surface very dark in color as compared with the surfaces of the other sections which appear mosaic. The surface was perfectly intact. The need for a renewal of the seal-coat is beginning to be in evidence.

In experiment No. 9, mixing was by hand. The binder was 18 gallons of crude tar per cubic yard of stone and the seal-coat was ¾ gallon of asphalt per square yard. Cost was $0.816 per square yard.

No ravelling has ever taken place upon this section. The only repairs necessitated to date have consisted merely in touching up spots where the seal-coat had disappeared. The expense of maintenance to date has been less than $0.005 per square yard. A smooth asphalt surface was presented by this section upon examination during October, 1914. There was no evidence of ravelling to be seen, but in a very few small spots the disappearance of the seal-coat allowed the top surfaces of the stones to be seen.

The following conclusions from the above described work and the regular work done since are drawn by the author:

These experiments at Barrington seem to prove that certain forms of the cold mixing method are very satisfactory upon roads subjected largely to motor vehicle traffic. Only two of the sections have necessitated repairs of any account during the five years they have been laid. Both of the sections requiring repair were laid with the same combination of binders, and the much greater extent of repairs necessitated upon the section constructed of trap rock is of interest in consideration of mineral aggregates.

It was shown conclusively that a seal-coat of asphalt is much more permanent than a seal-coat of refined tar, altho both the crude tar and the refined tars gave excellent results as far as their binding of the mineral aggregate is concerned.

The effectiveness of refined water-gas tar is also proven. The section built of this product is superior at present to either section built of refined coal-tar.

In 1910 the typical construction employed was a mixture of crude tar and crushed stone, seal-coated with a heavy asphaltic product. It will be noticed that this construction is identical with the construction employed in experiment No. 9 at Barrington the previous year. The facility with which the crude tar could be handled and the good results secured with this material previously, accounted for its extended use in 1910. The results secured with this type of construction in 1910 were very successful. With one exception these roads have required only the lightest of repairs to date, the exception noted being located upon the main street of a large village and constructed of commercial 2¼-inch and 1¼-inch trap rock. This road had disintegrated somewhat by the spring of 1911, and from that time on the disintegration rapidly became greater in extent. By the spring of 1913 the condition of the surface was serious. Several breaks of 10 square yards or more in area appeared, and small breaks were very numerous. It was decided to patch the breaks with a mixture of ¾-inch trap rock and refined tar and to apply over the entire surface a seal-coat of asphalt covered with clean ½-inch trap rock screenings. Asphalt of approximately 15 mm. penetration was applied at the rate of one-half gallon per square yard of surface and covered while hot with screenings, which were rolled with a 6-ton tandem roller as soon as possible. This work was done in June, 1913. The results of this treatment have proved very satisfactory, no further ravelling having taken place to date.

Mixing in 1910 was accomplished by

the hand mixing method upon wooden platforms.

The crude tar which was used to the greatest extent in our work during 1910 was the product of the Providence gas plant. Since 1910 vertical retorts have been installed at this plant and the crude tar at present produced is not suitable for use by the mixing method without previous refining. The Providence gas house tar used in 1910 was remarkable for its uniform good quality, and we doubt if we could duplicate the results secured that year with any crude tar at present available in sufficient quantity for our need.

In 1911 no appropriation for road work was made by the General Assembly and consequently no bituminous macadam was constructed.

In 1912 an attempt was made to duplicate in effect the excellent results secured in 1906 by the use of crude tar by employing a comparatively light refined tar. It was the express intention to apply to the roads built with this refined tar a seal-coat of asphalt as soon as need for such treatment was evidenced, thereby securing eventually the same type of road which was so eminently satisfactory in 1910.

Mechanical mixing was introduced into our work for the first time in 1912. The type of mixer employed upon practically all of the work was a cube mixer of approximately one-half cubic yard capacity fitted with a heating device. The stone was not heated previous to mixing, the heating device being employed merely for the purpose of keeping the inside of the mixer warm so that it would not become clogged. The heat was developed by a flame generated by the combustion of crude oil sprayed under pressure, and this flame entered the mixer. It is the writer's opinion that this direct flame was responsible for burning the bituminous material in several cases.

The stone employed in the mix upon the work in 1912 was both local 1½-inch stone and commercial 1½-inch trap rock. The results secured with the local stone averaged superior to the results with trap rock.

The results secured upon our work in 1912 were variable. In 1913 it was deemed necessary to seal-coat with asphalt approximately 42 per cent. of the total area of the roads constructed in 1912. During 1914 approximately 6 per cent. of the total area was seal-coated with asphalt. The roads which have not been seal-coated are in very good condition at present, but we anticipate the necessity for applying a seal-coat to all of them during the next two construction seasons. The seal-coating of the work done in 1912 has been very effective to date, but it is as yet too early to draw conclusions regarding the results of the 1912 work after seal-coating as compared with the results secured in 1910, where the seal-coat was applied at the time of construction.

During 1913 the amount of bituminous macadam constructed by the cold mixing method was small as compared with the amount constructed in 1912. Two methods were employed. The type of construction employed in 1910 was taken up to some extent with a refined tar in place of a crude tar—a seal-coat of asphalt being applied at the time of construction in exactly the same manner. An asphalt of characteristics similar to the asphalt employed upon experiment No. 4 at Barrington in 1909 was used to some extent in both mix and seal-coat. The work by both methods has proved perfectly satisfactory to date, although the construction is so recent that definite conclusions cannot be drawn. Trap rock was employed satisfactorily in the mix for the first time during 1913. The commercial ¾-inch size of trap rock was employed in place of the commercial 1¼-inch size which was previously used, and this product has given excellent satisfaction to date.

It has been proved in our work that the utmost care in constructing bituminous macadam by the cold mixing method is necessary. The crushed stone must be perfectly dry at the time of mixing and all stones must be perfectly covered with bitumen in order that good results may be secured. The manner of carrying out the rolling is also important in its effect upon the results obtained. It is, of course, necessary to secure by rolling as compact a mass as pos-

sible, but we have found that considerable care must be exercised in regulating the time and amount of rolling. If the weather is cool at the time of construction, we frequently postpone the heavy rolling until midday, when the maximum warmth is experienced, altho the initial rolling is done as soon after the mixture is laid as possible.

The character and sizes of the crushed stone employed are also of great importance. We have secured the best results, as far as stone is concerned, with our native rock, which is rather variable in character. As a rule our native rock is softer than trap rock and breaks with a much more irregular fracture than trap rock. There is more or less breaking of the native stone by rolling, and this appears to be beneficial rather than otherwise in that a denser pavement is secured. We feel that if trap rock is employed, smaller sizes are necessary than are necessary with a softer stone, unless there is a certainty of securing a perfect crusher-run from 1½ inch to ¼ inch or less.

We have experimented with heating the aggregate previous to mixing, but these experiments seem to show that inferior results are secured as compared with the results obtained with the same materials where the aggregate is unheated. The aggregate in bituminous macadam contains at best a large percentage of voids, and in the heated aggregate there was noted a tendency upon the part of the binder to run off from the stones, leaving only a very thin coating upon each stone. In several cases, for instance, 18 gallons of binder per cubic yard of stone were necessary to cover all stones in our unheated mineral aggregate, but when the aggregate was heated, 12 gallons would cover all the stones and there would be considerable bitumen which would run thru the mineral aggregate and be lost. The tendency for the bitumen to cover a heated aggregate very lightly seems to be due to the fact that the heat retained by the stones does not allow the binder to become hard for a considerable time, with the result that it continues to run for some time. We recognize that it is necessary to heat the aggregate in a dense mixture such as a bituminous concrete pavement affords, but in bituminous macadam work by the mixing method we prefer a cold aggregate or an aggregate heated but slightly.

The weather conditions influence the results obtained in bituminous macadam by the mixing method considerably. We have noticed that roads built late in the fall just before freezing sets in are not apt to be as satisfactory as those built in mid-summer, even though the temperature at the time of construction is not low. It seems to be a decided advantage to roads built by this method of construction to have a comparatively long period of warm weather immediately after construction in order that the surface may become freed from the top covering of stone screenings and well smoothed out before snow and ice appear. In Rhode Island we consider the season most favorable to this type of construction to be between the middle of May and the middle of October.

Upon the whole, the cold mixing method of constructing bituminous macadam as practiced in Rhode Island appears to be an economical pavement for motor vehicle traffic. It does not appear to the writer as suitable for heavy horse-drawn traffic or for a heavy mixed traffic. The traffic upon several of the trunk lines in Rhode Island consists of motor vehicle traffic to the extent of over 90 per cent. of the total amount of traffic, and it is upon these roads that we expect in the future to confine our bituminous macadam roads built by the cold mixing method. Thru large villages, where the percentage of horse-drawn traffic is large, we expect to take up a stronger method of construction.

MOTOR TRUCK FOR OILING ROADWAYS

By Frank Reed, Los Angeles, Cal.

THE latest factor in standardizing all features of oil macadam highway built in the city of Pasadena, under the policy developed by T. B. Allin, commissioner of public works, is a new Peerless four-ton truck, equipped with a tank provided with all necessary special apparatus for giving efficient distribution of heavy asphaltic oil used on this type of highway.

The tank has a capacity of 950 gallons. Oil is taken in from the pit thru an opening in the top of the tank at a temperature of about 325 degrees. Magnesia heat insulation holds up the temperature without any considerable loss during the time the oil is being transported and ejected on the highway, so that it comes out of the nozzles at a temperature above 300 degrees F. Pressure at the nozzles, as indicated by the pressure gage, is maintained at 15 to 30 pounds, as required by the depth of crushed rock to be penetrated, thru the action of a rotary pump located within the tank at the forward end, and manipulation of the valves of the pipes communicating with the header which feeds the nozzles, the pipe at the left being the feeder, and the one at the right a return pipe for conducting any surplus of oil not passing thru the nozzles back into the tank. An outlet valve in the feeder pipe, within the tank, is set to operate at 50 pounds pressure, should this ever be attained. The normal intake for the pipe is located in a sump hole at the bottom of the tank. Operation of a three-way cock affords a means of taking in oil from outside the tank, thru an opening provided for the purpose to which a pipe or hose may be coupled. A float gage, the indicator of which appears at the top of the rear face of the tank, shows the amount of oil it contains. Nozzles are subject to either individual or multiple control in two banks, each four feet wide. The header may be raised or lowered by means of a lever and ratchet mechanism at the right of the operator, who also controls the friction clutch gear for throwing in and out the pump mechanism run from the transmission of the truck.

MINIMUM SPRAY, *penetration and even distribution are obtained with new Pasadena road oiling truck.*

In operation, the truck is run at first or second speed, making the full speed allowed by the governor, which, in the Peerless truck, is closely regulated. In this mauner constant speed and corresponding evenness of distribution are secured, the amount of oil spread per square foot being varied at will of the operator with the pressure and speed of the truck.

An overflow pipe with its top in the dome extends vertically down thru the tank, opening below. This prevents any overflow at the rim of the dome, so that the outside of the truck is always clean,

PASADENA TRUCK *spraying water on test run, showing shape and overlap of jets, and features of mechanism.*

a very important factor in a city like Pasadena, having a wealthy and critical population, and also contributing to economy of operation, as it is not only easier to keep up maintenance of a clean truck, but men take a pride in doing so.

Comparing conditions since the arrival of the truck with those existing under the system of using tanks mounted upon horse-drawn vehicles, it is found that there is better regulation of the temperature of oil, an economy of about 25 per cent. in oil due to more efficient distribution, and further economies due to obviating chances for oil cooling in the tank, while at the same time the use of the special type of nozzles which deliver the oil in a spread jet and not in a foamy spray, in connection with the steadiness of operation, gives a better penetration and absence of streaky distribution, which makes a more uniform and permanent structure.

The city of Pasadena buys its own oil upon rigid specifications and tests, and sells it to the contractors who do the road work. The truck is rented to them at $3 per hour. This figure was fixed upon as one that would be approximately correct to cover all costs of owning and operating the truck. It will be checked up by a careful record based upon a year's use, and if it needs adjustment, will be changed on the basis of experience to a figure which will afford the city reimbursement for actual costs; but it is not intended to make a profit on the truck.

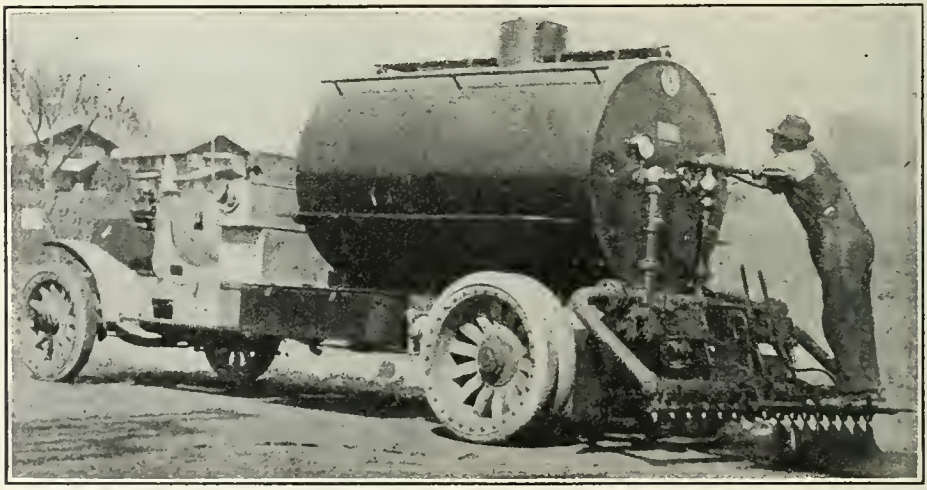
The tank body is so attached that it can be removed, and in about two hours a gravel dump body installed, the dumping device to be operated from the shaft which drives the pump in the tank. The strong construction of the transmission on the truck makes it possible to drive the pump in the heavy oil while the truck is in operation. It has a 4½x6½ motor specially designed for truck use, and the item of four speeds, with the second speed twice the first, is a very important one in securing proper regulation of the quantity of oil per square foot of road.

A CLEAR VIEW *of the front end, showing pump drive and arrangement whereby pump may be removed for repairs if necessary.*

Before purchasing the truck the city kept no cost data on a unit basis showing the cost of applying oil to its oil macadam highway. Figures obtained since the use of the truck indicate that there is a slight money economy in addition to the great improvement in quality of work, and the fact that the motor truck will serve three contractors in a day, while a wagon tank will serve but one.

The tank and spraying mechanism was built by Mills Iron Works, of Los Angeles, from designs by W. B. Cannon, chief road oiler of Los Angeles county, and the motor truck was supplied by Smith Bros., of Los Angeles.

CONTROL OF PRESSURE *is effected by manipulating the valves as shown in this view.*



WATER SUPPLY MAIN

FOR ATLANTIC CITY, N. J.

The Atlantic City, N. J., water works are located on the mainland, and it is necessary to pump the water thru long supply mains laid across the salt meadows and over or under the salt water channels thru them to reach the city, which is on the sandy beach of the ocean. The city has had long experience with steel, cast-iron and wood stave pipe for these mains, and this description of the latest line laid will be of interest as the result of its studies of the problem.

ATLANTIC CITY, N. J., has recently put in operation a new 48-in. water supply main which makes its water service safe and in very little danger of disturbance by accident. Formerly the city had a small cast iron supply main across the meadows, connecting with the waterworks pumping plant on the mainland near Absecon, and an old steel main, which had deteriorated to a shell of rust, so that one was inadequate and the other was in momentary danger of breakage. The only dependable main was a 48-inch wood stave pipe laid in 1910-11. It was considered unsafe to rely upon this main alone and, since investigation showed that the cast-iron pipe gave the best and most durable service, the present city administration decided to construct the new 48-inch cast-iron main which has recently been completed.

The pipe is 23,000 feet in length and 4 feet in diameter; it is of cast iron of the bell and spigot type, and its capacity is 25,000,000 gallons per day; its cost is approximately $415,000. The weight of the pipe and special castings is 8,800 tons. Eleven valves are placed at intervals thruout the length of the main, each weighing ten tons.

A new system was adopted in laying this great duct. Heretofore the mains across the meadows have been either fully or partially buried in the water-soaked soil. This is believed to have hastened deterioration, and it was decided to lay the new main above the surface of the meadows. This called for a secure foundation, which was provided by sinking piles at short intervals thruout the length of the pipe. The piles were placed in pairs and capped with cement bolsters, or beds, into which the pipe fitted. In the making of this bed 250,000 linear feet of piling was used and 3,685 cement bolsters.

One of the accompanying photographs shows the cement bolsters and the operation of lifting one of the great sections of pipe into its place, by means of a traveling crane on movable rails, which straddled the line of pipe.

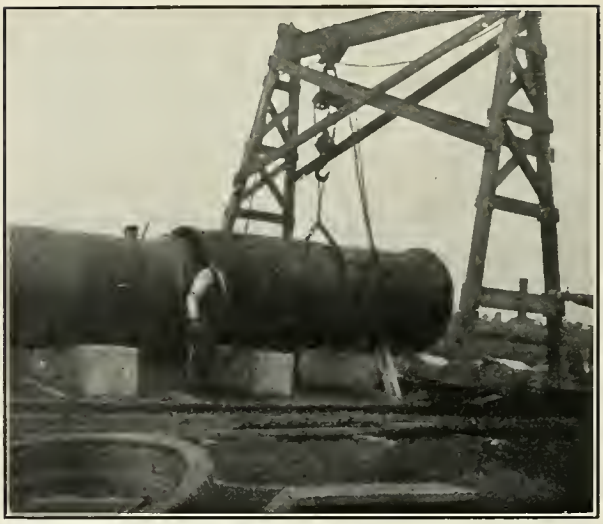
Another photograph shows the line of pipe on high cement bolsters at a crossing of one of the channels in the salt meadows, with men working on the filling of the pipe joints.

A third photograph shows the pipe on small bolsters near the ground alongside a railroad track and an anchorage pier.

The last photograph shows a section partly buried in the ground and one of the eleven valves above referred to, by means of which an injured section of the main can be shut off during repairs.

The method of construction and cost was tried out by letting first a contract for a small section of the main, 6,000 feet, which was completed in 100 days. The experience gained with this was such that the remainder of the main, 17,000 feet, was let at a considerable reduction in cost per foot, to another contractor, and was completed in 165 days.

The inverted siphon laid under the Thorofare was the most difficult part of



ATLANTIC CITY WATER MAIN. *Placing sections of 48-inch cast iron pipe in place on concrete cradles or bolsters.*

the work. At the point of crossing the tide runs about three miles an hour, and, as there is a good deal of boat traffic on the Thorofare, because of its being on the inland water route, the difficulties were greatly increased.

The specifications required sixteen lengths of pipe, a total length of 192 feet, to be laid on a horizontal plane and calked together with lead joints. It was suggested by the engineer that the ends be closed, water let in gradually, when, it was thought, the pipe would sink to the bottom to its proper position.

This method of laying the pipe was tried by the contractor, but the contained water all flowed to one end, causing that end to go down to the bottom first, and, instead of being in its proper position when laid, the pipe was to one side and the joints were badly strained.

This necessitated taking the pipe up again and doing the whole work over. The contractor was very much disheartened, and was not in position to run the risk of any further loss, and transferred his contract to E. L. Bader.

Mr. Bader attempted to lay the pipe in the same manner; that is, sixteen lengths, or 192 feet, calked together with lead joints, but with guide piles driven on each side and with the extra precaution of having tackles at intervals. to prevent the pipe from going down either end first, as happened with the other contractor.

The pipe was all made up, heads put on each end, water let in and the pipe again started on its way to the bottom, but with only enough water to overcome the bouyancy of the contained air.

Before the pipe was entirely submerged a motor boat passed and the waves that

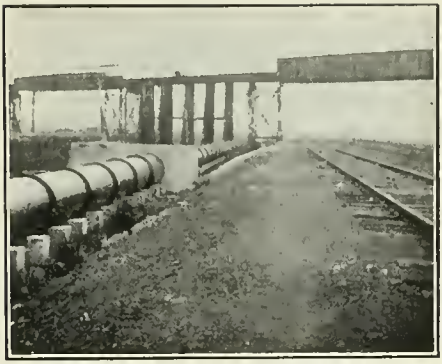
ATLANTIC CITY WATER MAIN. *Section partly buried, with one of the eleven valves which divide the 23,000 feet of pipe into sections.*

it made were just enough to again send tho water to one end. Thls time the end dld not go down to the bottom beeause it was held by the taekles, but the operation of lowering it had to be stopped until the pipe could again be made level.

The tremendous load then imposed was too great and the east-iron pipe itself broke in the middle. The weight of the pipe is 750 pounds the lineal foot, making a total weight of 144,000 pounds for the pipe alone, not ineluding the weight of the lead and the water eontents.

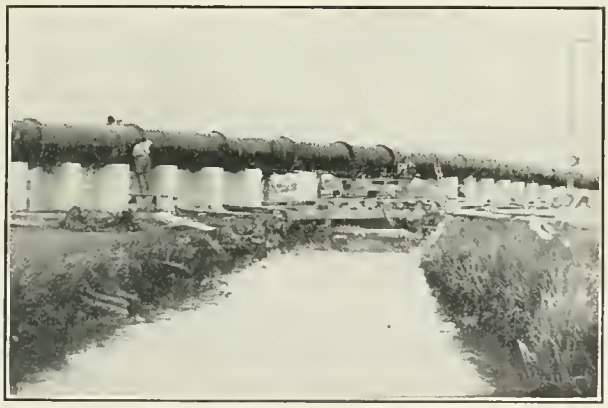
Again the pipe had to be taken up off the bottom and the job begun anew, and the conclnsion was reached that it was impractical to eomplete the work aeeording to the original specifications.

Instead of putting together the whole sixteen lengths, there were two sections of eight lengths eaeh and the pipe without any heads was lowered into place with differential blocks and the joint in the middle was made by a diver at the bottom of the Thorofare.

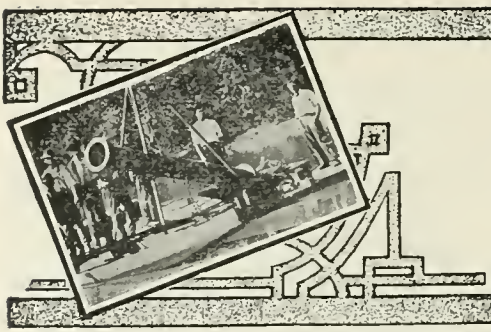


ATLANTIC CITY WATER MAIN. *Completed section of 48-inch main on low bolsters. Note conerete pier on the pipe line.*

We are indebted to W. H. Kirsehman, assistant engineer in the water department, for the accompanying photographs, and to *Atlantic City Commission Government* for the data presented.



ATLANTIC CITY WATER MAIN *on high bolsters at crossing of channel in salt meadows. Men joining the pipes.*



EDITORIAL

RECOVERY IS RAPID.

Now that the first effects of the shock from the outbreak of the war have passed, the magnitude of the injury to the world's financial system can be seen more clearly, and the wonder is that the recovery has been so rapid during the past three or four months.

Unquestionably the world must suffer as a whole from the wanton destruction of so much wealth, and it has suffered in the past from the devotion of so large a proportion of its wealth to the preparation and construction of so much material and of so many engines for such destruction. It may be doubted whether the one effect is actually any greater than the other, except for the brief period after the shock of the commencement of the destruction and the consequent shattering of a large share of the world's provisions for doing business.

It is equally true that nations which are not involved in the conflict must profit by the changes in the world's business, whether they wish to or not, and that if they seize the opportunities they can profit enormously. It is likewise true that it is their duty to take up the work so wantonly abandoned by the warring nations and carry it forward for the benefit of that portion of the world which has retained its senses.

However, those who have studied ultimate causes are of opinion that the differences giving rise to the war are fundamental and must be fought to a finish, either now or later, and that this is apparently the time at which to settle for centuries the recurring conflict between the state as the object for the benefit of which all individuals exist and the state as existing for the benefit of the individuals composing it. They believe the war will be long continued.

The long lists of items of daily history which demonstrate the rapidity of the recovery of the United States from the sudden stoppage of all the ordinary methods of exchange with foreign nations need not be repeated here. It is sufficient to refer to it and to the improvement in domestic trade and manufactures, which is gathering greater force every day. The enormous contracts placed in this country by the warring nations have started some lines of manufacture ahead of the rest, but they are all following after or preparing for early resumption.

The development of new trade with the other neutral nations of the world must be a slower process, but it also is advancing with rapid strides, and the business of this country will increase in geometric ratio for many months to come.

In the field covered by MUNICIPAL ENGINEERING the improvement is marked by that in the market for municipal bonds, especially in those intended to pay for public improvements, and an equally rapid development in this field is now in sight.

It has been argued that the great demand for capital made and to be made by the governments of the warring nations to pay the expenses of the war and to rebuild their damaged public works will make interest rates high, and this argument seems to have some support from present market rates for money. But, on the other hand, it must be remembered that these same nations, and others in less degree, have been pouring vast sums into preparation for this conflict, and have been locking up vast sums in their treasuries, which are now being expended for supplies drawn from all parts of the world, and so distributed where they can again enter the channels of commerce, so that it is quite possible that the use of capital will not be charged for even at the present rates for many months. Meantime the increase in business and the probable increase in profits will make it easy to pay the extra interest demanded. This situation is relieved somewhat, so far as the United States is concerned, by the releasing of reserves effected by the installation of the new banking system, and will be further relieved by the adoption of the new basis for the currency of the nation, which is so important a feature of the new system.

MUNICIPAL GOVERNMENT

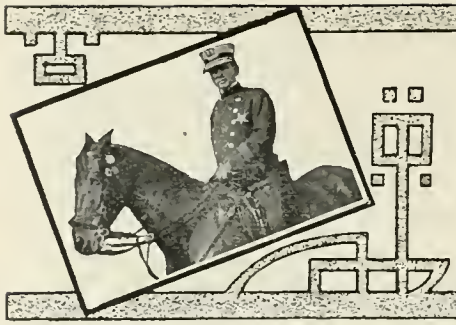
Buffalo, New York, is the largest city which has adopted the commission form of government, the vote in its favor by the citizens last month being decisive.

Where the commission form has been successful it has been largely because the cities were small and the voters could therefore be better informed regarding the qualifications of those voted for, and because the work to be done by them does not, ordinarily, demand the expert qualifications which are essential to successful administration of the concerns of large cities. The results in Buffalo in this line will be watched with interest.

It has been suggested several times in this department that one of the reasons for the success of the commission form of government has been the removal of the municipal elections as far as possible from the influence of partisan politics. This should be the aim in reforming municipal affairs and the more thoroly it has been done the more satisfactory have been the resutls.

English and German cities are governed on quite different principles. German cities are largely under home rule, excepting as to the exercise of police powers, with but little actual supervision of details by the state. English cities, on the other hand, are under close supervision of state boards which look carefully after details. But in each country the affairs of the cities are considered as business affairs not connected with the policies of state government, and city elections are mainly independent and primary, without party or group nominations.

So far as American cities have followed this principle they seem to have improved their conditions, whether they are permitted home rule or not, and whether they follow the business principles of retaining competent employes during good behavior or not, tho such experience as we have indicates that both of these lines are further leaders to improvement. Possibly the experience of a large city in the commission form will serve to separate to some extent the reasons for improvement and give us a better understanding of their action, so that there will not be so much tendency to attribute improvement to the wrong causes or to a single cause when several are involved.



QUESTION DEPARTMENT

Fittings for Playground Apparatus

We are anxious to get prices on a 4-way fitting for horizontal bar, consisting of three 2-inch pipe legs and 3-inch pipe horizontal and would like the names of those who make these fittings. K., Portland, Ore.

Good results are obtained by purchasing the specials, such as the one described, from the manufacturers, and having a pipe fitter cut the pipe and put the apparatus together. A dimensioned drawing for installation of any combination of standard set of apparatus desired will be found in MUNICIPAL ENGINEERING, vol. xliv, p. 9, January, 1913, with hints as to method of erection. Photographs of the apparatus are also given. Following are names of makers of playground apparatus, most of whom will supply the specials as well as full sets of apparatus:

Everwear Mfg. Co., Springfield, O.

Fred Medart Mfg. Co., 3550 Dekalb street, South St. Louis, Mo.

Playground Apparatus Co., 102 Main street, Toledo, O.

Geo. Howard Steel Playground Apparatus Co., Philadelphia, Pa.

International Gymnasium Supply Co., Springfield, Mass.

Harry E. Miller, 127 North Mellick avenue, Philadelphia, Pa.

Playground Apparatus Mfg. Co., Templeton, Mass.

A. G. Spalding & Bro., 125 Nassau street, New York City.

W. S. Tothill, 122 North Webster avenue, Chicago, Ill.

Municipal Conduit Systems

We have an inquiry for information on municipal conduit systems, in the United States and in Canada. Are you able to give us any data concerning such systems, or references to sources where we may obtain it? Also, can you tell us if the idea generally has been found to be a failure?
T. Chicago, Ill.

The municipal conduit for electric wires in Westfield, Mass., is described in MUNICIPAL ENGINEERING, vol. xlii, p. 220, and that in Lincoln Park, Chicago, in vol. xl., p. 443. There is a general article in vol. xlii, p. 362. The conduit systems in Auburn, N. Y., and Erie, Pa., are described in earlier numbers. These conduits are mainly of municipal ownership. There are numerous others under more or less complete municipal control. Baltimore, Md., has nearly $2,500,000 invested in its subways for pipes and wires. Utica, N. Y.; New Britain, Conn.; New Castle, Pa., are other cities having $45,000 to $60,000 invested in conduit systems.

Philadelphia, Pa.; Davenport, Iowa; San Francisco, Cal.; Grand Rapids, Mich.; Salem, Mass., are other cities with 95 to 1 mile of municipal conduits occupied at least in part by wires other than those belonging to the city. St. Joseph, Mo., and Lancaster, Pa., also have short conduits under municipal ownership.

Detroit, Mich.; Milwaukee, Wis.; Chicago, Ill.; Seattle, Wash.; New York, N. Y.; Boston, Mass.; Washington, D. C.; Cleveland, Ohio; Fall River, Mass.; Buffalo, N. Y.; Minneapolis, Minn.; Portland, Me.; Portland, Ore.; St. Louis, Mo.; Pittsburg, Pa.; Oakland, Cal.; Pueblo, Colo., are other cities owning conduits which are used entirely or almost entirely by the city alone, the first named having over 120 miles and the last four less than 1 mile each.

Chemical Periodicals

Please give a list of periodicals pertaining to chemistry and chemical analysis.
B., ————, Cal.

Following is a list of periodicals devoted to chemistry:

Western Chemist and Metallurgist, Denver, Col., $9.

American Chemical Journal, Baltimore, Md., $5.

Journal of Physical Chemistry, Ithaca, N. Y., $4.

Chemical Abstracts, Easton, Pa., $6.

Journal of Industrial and Engineering Chemistry, Easton, Pa., $6.

Journal of the American Chemical Society, Easton, Pa., $6.

Chemical Engineer, Chicago, Ill., $3.

BATHING BEACH *on lake in Washington Park, Denver, Colorado. Bathhouse is on the right of the beach.*

A Bathing Beach in Denver

Denver, Colorado, has developed a number of bathing beaches in natural and artificial bodies of water in its parks. The beach in Washington park has been developed from an old swimming hole, first by driving piles thru the ice in winter to define the safe limits of the swimming place in the lake; the piles being connected by ropes in the season. The beach was covered with sand, and piers with springboards were built out into the water. Advantage was taken of an old grove of cottonwoods for shade. Then a modern bath house with six showers and locker accommodations for 500 men and 150 women was erected. The plant is used daily by several hundred, and on Saturday and Sunday the attendance runs into the thousands. From 25 to 30 per cent. of the patrons are women and girls.

Those having their own bathing suits are charged 2 cents for towels. To rent a bathing suit a deposit of $1 must be made, and the charges are 15 cents for suit and towels, 5 cents for cap and 5 cents for stockings, if required.

Concrete Streets on Steep Grades in Mankato, Minn.

Mankato, Minn., has paved with concrete this year, fifteen blocks of residential streets, a total of 16,888 yards. The longest stretch is on Fourth street. The other pavements are on Plum, Mulberry and Washington streets, and have grades ranging up to 14.3 per cent.

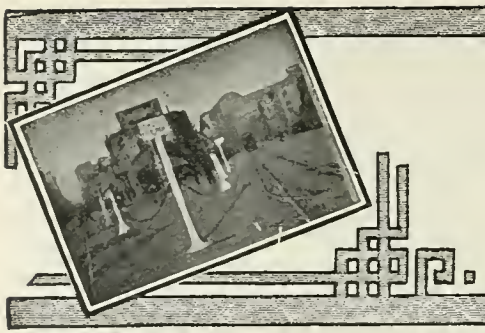
Pavements are 6 inches thick and 27 feet wide between gutters with expansion joints at 26-foot intervals. They are crowned 4¼ inches at the center and 3 inches at the quarter point, giving a section that insures good drainage and a comparatively flat central portion where the traffic is heaviest.

Aggregates consisted of gravel and sand from the Minnesota and Blue Earth rivers. With a crew of 26 men the contractor was able to lay an average of 516 yards per day.

Good curing for the freshly laid concrete was afforded first by sprinkling for five hours and by covering the next morning with 2 inches of dirt which was kept wet for ten days. After twenty-one days the earth was removed, and the streets thrown open to traffic.

When paving was in progress an opportunity was afforded the contractor for doing other concrete paving work in the vicinity. Materials and machinery are at hand and both contractor and property owner profit. In Mankato five private alleys and driveways were built at the same time as the new streets. Specifications for alleys and driveways were similar to those for streets.

The Widell Co., of Mankato, was the contractor and work was in charge of H. F. Blomquist, city engineer.



WORKERS IN THE FIELD

Dayton Bond Issue Voted Down

The Editor of MUNICIPAL ENGINEERING:

Sir—The Dayton (O.) City Commission put up to the people for ratification at the election Tuesday, November 3, two bond issues, one for $250,000 to be used in buying several dumps and improving them for parks and playgrounds; the other for $1,000,000 to be used in defraying the city's share (53 per cent.) of the cost of elevating the joint tracks through the heart of the city.

About the same time the Socialist party petitioned the city commission to bring before the voters a bond issue for $500,000 to construct and operate a municipal electric light plant. The city commission turned this proposition down, believing it would be financially inexpedient to engage in the electric light business with a comparatively small plant in competition with a private corporation which is now rendering adequate service at a fairly reasonable rate, but enough signatures to demand a referendum were obtained.

At the same time the Greater Dayton Association began an active campaign for the passage of the bond issues for parks and playgrounds and grade crossing elimination and the defeat of the bond issue for the municipal lighting plant. The vote Nov. 3 had the following results:

	For.	Against.
Parks and playgrounds.....	9,784	16,931
Grade crossing elimination..	10,453	15,872
Municipal light plant.....	9,175	15,173

The one great factor in the adverse vote on the bond issues was the present business conditions and the feeling of financial stringency prevalent thruout the country. There was also sectional opposition, as some parts of the city were opposed to track elevation because the plan did not include the elimination of the grade crossings in these suburban districts. Other parts of the city were provided with parks and therefore took an independent attitude upon this question. The municipal light plant, of course, attracted a large number of voters who favor municipal ownership in any form without regard to the reasonableness of the question at hand.

The result of the vote puts the present administration in a better position than it was previous to the election, inasmuch as there has been considerable agitation for track elevation and parks and playgrounds, and now all responsibility for failure to secure these things has been placed upon the people at large. There would undoubtedly have been criticism of the city administration if these questions had not been put before the voters at this time.

S. H. ANKENEY,
Publicity Manager,
The Greater Dayton Association,
Dayton, Ohio.

A Septic Tank for Small Communities

The Editor of MUNICIPAL ENGINEERING:

Sir—The need for sewage disposal increases yearly and small communities are becoming more and more impressed with the necessity of disposing of household and industrial wastes. With the idea of co-operation in the matter, we offer the following plan of a septic tank for small communities.

The tank is constructed entirely of concrete, and is divided into two compartments by a concrete wall running lengthwise thru it. A series of baffles are constructed as shown (Fig. 1) numbered 2, 3, 6 and 7, making an angle of 110 degrees with the concrete walls in the direction of flow. The tops of the baffles are one foot above the flow line and hence serve also as scum boards. The purpose of the baffles is to check the rate of flow of the sewage thru the tank, and they should not make angles of less than 90 degrees with the walls because of the tendency to produce eddies, which would thereby defeat the purpose of the tank.

The bottom of the tank is made to slope gradually (6 inches in 50 feet), being deeper at the inlet than at the outlet. This facilitates the concentration of the

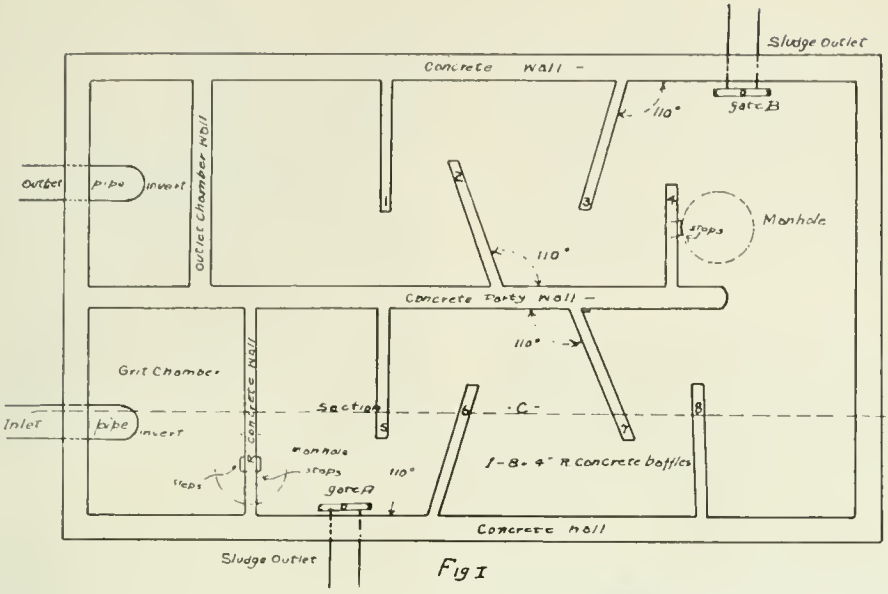


Fig 1

PLAN OF SMALL SEPTIC TANK *for village or large institution, taken at Section C in drawing below.*

VERTICAL LONGITUDINAL SECTION *of small septic tank for village or large institution, taken on the line marked "Section C" in the plan above.*

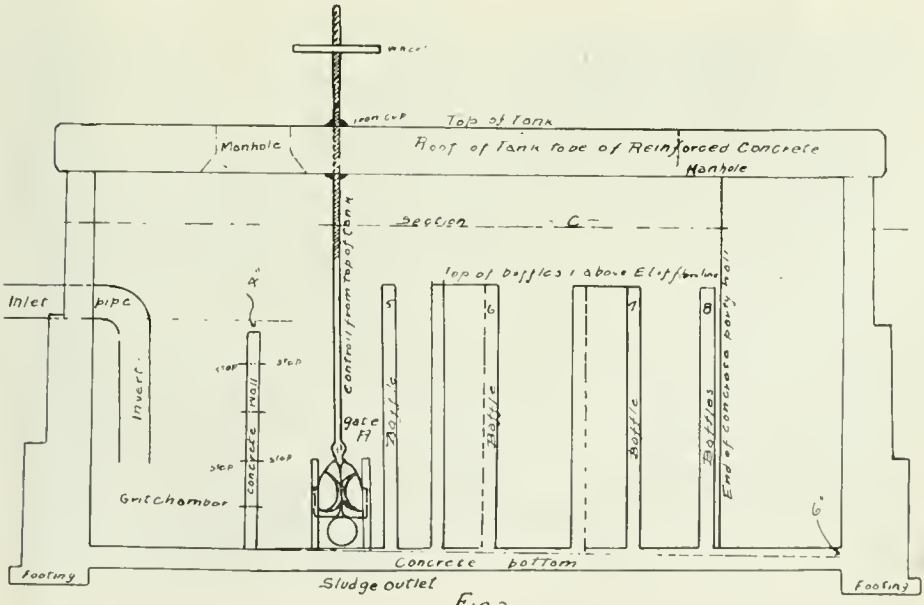


Fig 2

sludge in two places, and it may then be run into a concrete pit below the tank thru the gates A and B, which are controlled from the roof by hand wheels. The roof is constructed of reinforced concrete.

The sewage, after being screened, passes thru the inlet pipe into the grit chamber, thence over the grit chamber wall, thru the tank around the baffles and out thru the outlet pipe to the filtration beds.

EDWARD J. KELLY AND JESSE WATTS,
245 Union Ave.,
Mt. Vernon, N. Y.

Vicksburg's Water Works Situation

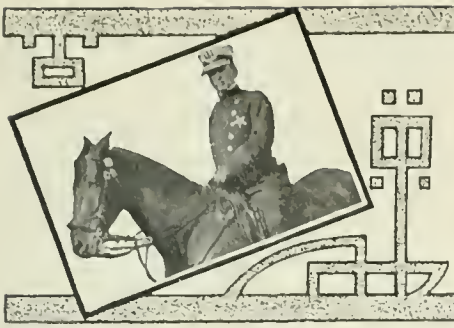
The city of Vicksburg, Miss., has been having a rather long controversy with the Vicksburg Water Works Company over its water works plant and has made several plans and specifications for a plant to be built and owned by the city and put in operation when the water works company's franchise expires with 1916. The latest move of the city was to receive bids for the construction of a plant on plans and specifications which seem to have been trimmed to bring the cost as near as possible to the $400,000 fund on hand from the sale of bonds. The bids were received on September 12, 1914, and were published October 24, and the total cost of the new city plant ascertained from them is reported to be $450,429.65.

The water company has issued a pamphlet in which it compares its own plant, as it exists, with the proposed new plant, especially as to points in which the new plant would be inferior to the old plant and as to items of cost not included in the bids, with the purpose of showing the advantages of purchasing its plant at its present offer of $340,000.

The controversy seems to have reached a very unfortunate stage and to be one which could be amicably and equitably settled if the parties to it would agree to submit the question of the value of the company's plant to a board of competent and unbiased engineers, so that the merits of both sides might be determined accurately and completely and without influence of bias or prejudice. If this were done, and the judgment of the experts was not rejected on account of official prejudice, it would not take long to settle the question in the way most equitable for all concerned.

A New York Public Comfort Station

The accompanying photograph shows one of the public comfort stations in Manhattan, New York City, and the care exercised in their design and construction. This station is located on Forty-second street, adjacent to the Public Library, the large building seen in part in the background. As a consequence of this location the station must be elaborate in design and excellent in construction sufficiently to conform with the magnificent structure with which it is connected. That the city has taken full care of these points is shown by the photograph.



LEGAL DECISIONS

Rochester Can Specify Bitulithic

The injunction restraining the city of Rochester from letting the contract for a bitulithic pavement in Culver road from East avenue to the canal bridge is dissolved in a decision filed by Supreme Court Justice W. W. Clark, October 28.

The real question at issue is whether there can be any competitive bidding, as the city charter requires, when bitulithic is used as the paving material. This material is a patented article, manufactured by one company, Warren Brothers, of Boston, and the Whitmore Company alleged that because of this fact there could be no competition. Justice Clark takes a different view. He says that the owners of the patent opened the way for competitive bidding when they offered the uses of their patented product at a fixed price to any contractor who desired to bid on the whole.

"The adoption of specifications for a patent pavement does not prevent competitive bidding and that proposition has been decided many times and in many states," says Justice Clark in his decision. "There is nothing in the charter of the city of Rochester which prohibits the common council from adopting bitulithic pavement for a street improvement, if that was desirable, and there is nothing in the charter which would preclude property owners from designating bitulithic if that was the pavement which seemed to them most desirable, and there is likewise nothing in the charter of the city of Rochester which prohibits the authorities from using for such an improvement a patented article.

"The bitulithic pavement," continues the court, "which was desired by the property owners who were to pay for the improvement and which was adopted by the city authorities, and for the construction of which they invited bids, is a kind of product or patent pavement covered by perfectly valid letters patent. It is not merely a certain make, style or brand of material; and in adopting bitulithic pavement for the improvement in question the principle of competitive bidding was not destroyed but was distinctly preserved in this transaction, as is shown by the fact that there were a number of bids submitted in good faith, and the contract was awarded to the lowest bidder, even as against the owner of the patented article."

Sections 115 and 230 of the charter of the city of Rochester provide that, "A majority of the property owners liable to be assessed for the cost of paving or repaving a public street, highway or place, owning not less than two-fifths of the feet front of property * * * may at any time within one week after the ordinance for the improvement takes effect present to the board of contract and supply a petition or other writing, designating one of the materials specified by the common council as the material to be used in constructing the pavement, but may not designate therein any particular kind, make, style or brand of material."

Decisions of the Higher Courts of Interest to Municipalities

City Must Have Charter Authority to Borrow Money—The power to borrow money and incur indebtedness is not an incident to the governmental powers of municipal corporations, and cannot be exercised unless conferred by the charter. Merchants Loan and Trust Co. v. City of Chicago, (Ill.) 105 N. E., 726.

Cost of Water Mains May Be Refunded to Property Owners—In view of local improvement act, sec. I (Hurd's Rev. St. 1913, ch. 24, sec. 507), providing that municipalities may construct local improvements by special assessment, by special taxation of contiguous property, by general taxation, or as otherwise provided by ordinance, sec. 4, declaring that when any city shall provide for the making of any local improvement the same ordinance shall prescribe whether it shall be made by special assessment or special taxation of contiguous property, or general taxation, or both, does not restrict the municipality to the modes specified, and hence a municipality may pay for the

laying of water mains with money furnished by abutting owners and provide for reimbursement of such owners, with interest out of the general revenue from the mains. Idem.

Taxing Railroad for Street Improvement—Where land of a railroad company is used only for its tracks used in transportation, there is no enhanced value of the land from the improvement of an adjoining street by the construction of a tile subdrain on each side of the street and a storm sewer on part of the street, and the land cannot be taxed for benefits therefor. Where a part of a railroad right of way adjoining a street improved by the construction of a tile subdrain and a storm sewer is not benefited thereby, while another part devoted to business uses is benefited, it is not improper to tax the whole right of way in the amount of the benefit instead of dividing the right of way in levying the tax for benefits. City of Kankakee v. Illinois Central Railroad Co. (Ill.) 105 N. E., 731.

City Liable for Neglect of Contractor.—A municipality can avoid liability for negligence of an independent contractor in the construction of a public work unless the matter involved is one of positive duty to an individual and in its nature nondelegable or the work is intrinsically dangerous or liable to create a nuisance, in which case it is liable, and the duty cannot be evaded or cast upon others. A municipal corporation is under no obligation to keep a navigable river within its territory free from obstructions. Where a bridge across a navigable river within the limits of a municipality was removed and a new one constructed by independent contractors, under permission from the War Department to the city, a positive duty was placed upon the city to keep the river free from obstructions in the performance of the work, which duty could not be delegated to the independent contractors. Hosford Transp. Co. v. City of Portland (Ore), 141 Pac. 1016.

City Liable for Injury from Tipping of Catch Basin Cover.—An iron lid over an opening in the covering of a surface water drain maintained by a city between the curb and sidewalk space, near the intersection of streets, where street cars stopped and those waiting for cars would stop and were liable to stand, having for a long time been in such condition that it would tip when one would step on it, the city was charged with notice, making it liable for injury to one from its tipping when she stepped on it while so waiting for a car. Rickards v. Kansas City (Mo.), 168 S. W. 845.

Liability for Damage by Pollution of Stream by Septic Tank Effluent.—Where a sewer improvement district constructed a sewer and a septic tank, in which the sewage was chemically treated under a plan contemplating the discharge of the sewage, after being treated, into a stream, the district, and not the city, was liable for the damages of a riparian owner caused by discharging the sewage into the stream, tho the city after the completion of the sewer had control thereof; such damages being an incident to the construction of the sewer. City of El Dorado et al. v. Scruggs (Ark), 168 S. W. 846.

Water Company's Franchise Annulled.—Complainant city (then town) in 1892 by ordinance granted a franchise for fifty years to defendant and others, whose interests he afterwards acquired, to construct and maintain waterworks to supply the town and its inhabitants with water "to be conveyed from creeks * * * known as Mink and Gibson Jack creeks," and to be in quantity sufficient to supply both the public and private uses of the citizens of the town and of pure and healthful quality. Afterwards rates were agreed upon and established. In 1901, the town having become a city and largely increased in population, an ordinance was passed reciting that, the then supply of water having become inadequate, defendant agreed "to bring in the waters of Mink creek" and to make all extensions warranted by the growth of the city, involving a large expenditure of money, in consideration of which the city confirmed the previous grant, agreed to rent a certain number of additional hydrants, that the prevailing rates should not be changed for five years, and only at intervals of five years thereafter, and then only on specified conditions, and that the city would not grant a more favorable franchise to another nor own a water system of its own until it had offered to purchase defendant's system at a price to be fixed as therein provided. The ordinance was accepted by defendant. The bill alleged, and the proof showed, that defendant had brought in but a small part of the waters of Mink creek, had failed to make the required extensions or to keep existing pipes in repair; that, on the contrary, he had reduced the supply by making regulations restricting the use of water and placing "reducers" in the supply pipes to the extent of preventing the city from obtaining water for street sprinkling or fire protection and the inhabitants for domestic purposes, to the injury of their health and property. Held, That such ordinance required defendant to bring in all the waters of Mink creek as well as to make the specified extensions, for which he received consideration in the concessions made by the city, and that, on the facts shown, the city was entitled to a decree annulling the ordinance. Murray v. City of Pocatello (Ida.), 214 Fed. 214.

WATER

Water Works Improvements at Toledo, Ohio

The more important improvements which have been made in connection with the Toledo water supply include the installation of a 30,000,000-gallon pump in a new fireproof section of the pumping station and the rewiring of the pumping station; bids have recently been received for two new 500-h.p. boilers and it is planned to make cross-connections between the force mains outside the pumping station early in 1915.

A filter plant has been installed two miles above the pumping station, with three 15,000,000-gallon and one 5,000,000-gallon low-lift pumps, thirty-four mechanical filters, each of 1,000,000 gallons capacity, a 5,000,000-gallon clear water basin and, at the pumping station, a 15,000,000-gallon suction reservoir.

The complete installation of the distribution system and hydrants for a separate high pressure system with two temporary connections to the general system, and the setting of additional low pressure hydrants in the congested value district, have recently been accomplished. The separate high pressure system practically covers the area north of the river, bounded by Washington, Michigan, Jackson, Superior and Cherry streets, and is made up principally of 10-inch pipe, with a 12-inch cross-feeder and 16-inch main supply line. The site for a high pressure pumping station at the foot of Cherry street has been purchased and bonds have recently been sold for proceeding at once with the erection of the building. Important mains that have been laid or are being laid include: A 30-inch along Whitney, Detroit and Central avenues from Cancroft to Fulton streets, a 24-inch from the pumping station across the river to the southerly end of an 8-inch line on Oak street, East Toledo, a 24-inch on Erie street from Mulberry street to Buffalo street, an extension of the 12-inch on South Broadway to the city limits, 12-inch on Washington street from Erie street to St. Clair street and a 12-inch from Front street east on Kelsey avenue, East Toledo; it is planned to lay a 30-inch main in Cherry street from Erie street to Central avenue before the end of the present year and several 12 to 24-inch extensions are contemplated in 1915. Until the 30-inch contemplated for 1915 is installed, the mains already laid will have very little effect on supply to the congested value district.

In the fire department, the total membership has been increased from 201 to 234, with a fire force of 222; a combined engine and ladder company established at Detroit avenue and Nessle street; Engines 2, 3, 5 and 8 equipped with tractors and Engine 7 mounted on an automobile chassis; automobile combination hose wagons provided for Engines 3 and 7, an automobile aerial ladder truck put in service at headquarters and an automobile city service truck in Engine 7. Trucks of the latter type are about to be installed with Engines 3 and 5.

The removal of the fire alarm headquarters to a fireproof building is of vital importance. The present headquarters building is obviously in danger of collapse and has been condemned as unsafe for occupancy by state and local authorities; it contains large quantities of highly combustible materials used in occupancy and construction, with serious exposures from surrounding buildings. The possibilities of serious interruption, leaving the entire city without fire alarm protection, are most alarming. The site for a new building has been decided upon, but no other definite steps have yet been taken.

Regulation of Water Rates

The ordinance granting a water supply franchise to the Pocatello Water Company, of Pocatello, Idaho, has the following provisions regarding determination of rates for service at regular intervals of time and for determination of value of plant for purchase by the city:

Sec. 3. The foregoing rates and charges are hereby adopted by the city of Pocatello, by and for itself, and as trustees for

the use and benefit of all private consumers of water within the corporate limits of said city for a period of five years from and after the passage and approval of this ordinance. At the expiration of said time, if the earnings of said water system shall exceed five per cent. above reasonable expenses upon the value of said water system as then agreed upon, or as may be ascertained as hereinafter provided, then the rates as set forth in the "Schedule of Water Rates" of section two of this ordinance may be readjusted so as to yield not less than five per cent. above reasonable expenses on the valuation, but no readjustment shall hereafter be made that will yield less than five per cent. above reasonable expenses, on the value of the investment ascertained as hereinafter provided for in section four.

Sec. 4. If, at the expiration of five years, or at any time thereafter, it should be deemed necessary to readjust rates under the provisions of section three, and if the city of Pocatello and the said James A. Murray, or his successors or assigns, cannot agree upon the value of said water system, for the purpose of such readjustment, then the value of said water system shall be ascertained and determined in the following manner, to-wit: A committee of four experienced and disinterested hydraulic engineers who must be members of the American Society of Civil Engineers, shall be selected, two by the city of Pocatello, and two by said James A. Murray, or his successors or assigns, and the following questions shall be submitted to them: For what sum can the water system of James A. Murray be now duplicated? If a majority of the four cannot agree they shall elect a fifth, and if they cannot agree upon a fifth, they shall request the president of the American Society of Civil Engineers to appoint a fifth member. The decision of a majority of the committee so selected shall fix the value of said water system for the purpose of readjusting said rates and such decision shall be final.

Sec. 5. The city of Pocatello shall not hereafter grant to an individual, corporation or association any terms or franchises for the construction or operation of a water system more favorable than the terms and franchises now held, confirmed and continued in said James A. Murray; nor shall the city of Pocatello build, acquire, own or operate a water system of its own, until it has in good faith offered to purchase the water system of the said James A. Murray, or his successors or assigns, at a price to be ascertained as follows: If the owners of said water system and the city of Pocatello cannot agree upon the price then a committee of experienced and disinterested hydraulic engineers, who must be members of the American Society of Civil Engineers, shall be selected in the manner set forth in section four of this ordinance, who shall fix the value of said water system for the purpose of such sale, and the decision of a majority of such committee shall be final. At intervals of five years from the approval of this ordinance and during the period of ninety days immediately following the completion of each five year interval, the city may purchase the water system of the said James A. Murray or his successor or assigns, under the conditions specified in this section, but at no other time except by mutual consent of the city and the owner of the said water system. In fixing the value of said water system, whether for the purpose of selling or of readjusting rates, the water system of the said James A. Murray, or his successors or assigns, shall be held to mean and include all of the pipes, mains, hydrants, conduits, ditches, reservoirs, dams, water rights, rights of way, natural and acquired advantages, franchises, implements, storage grounds, material on hand, and all rights and property of what kind soever, either in use or on hand and belonging to the said James A. Murray, in his capacity of furnishing water for any and all purposes to himself and to his customers, at Pocatello, Idaho, saving and excepting account books, and records; and each article of property aforesaid shall be separately considered and evaluated by said committee, and in the event of the city of Pocatello purchasing said water system under this ordinance, said James A. Murray shall transfer all his rights, title and interest in and to said property to said city, and the said city shall receive and pay for the whole plant as aforesaid, the said James A. Murray stepping out, and leaving all said property undisturbed and ready for the city to step in.

Limitations of Water Filters

By George W. Fuller, Consulting Engineer, New York City, before the American Society of Municipal Improvements.

The treatment of water supplies, in order to secure water of proper sanitary quality, in connection with the treatment of sewage affecting these supplies, is one of the great questions of the day in its bearing on public finances. These two subjects are closely related, and, due to the large financial outlay necessary to obtain required results, their correlative value and efficacy should be closely studied.

Most American cities have available within their reach a source of water supply still capable of purification by the ordinary modern methods of filtration and

sterilization. The growing demand for public improvements in recent years has amply demonstrated that the public treasury is not inexhaustible, many large cities having already closely approached their legitimate bonding power.

As would logically follow, centers of population have resorted, and do resort, to the cheapest and quickest method of obtaining the required sanitary results, namely, the purification of the amount of water that they need for their own use, rather than the more expensive and possibly illogical method of treating all sewage on the water-shed in the hope that the supply may be maintained of sufficient purity to avoid special treatment. This is a logical, economic development, and altho selfish in its basic elements will probably prevail as long as it produces the required results and until the present methods of water purification fail. When the sanitary and aesthetic limitations of water purification have been reached, and it becomes necessary to eliminate by this or some other treatment the sources of pollution from the water, the public policy of handling the question must change accordingly.

The prevention of the pollution of large water supplies, which still retain great reserve capacity for dilution, does not seem to warrant either the close study or immediate financial outlay that the treatment by modern methods of the water supplies drawn therefrom, warrants.

Commendable as is the prevention of water pollution, nevertheless immediate results are demanded. The difficulties, financial and otherwise, of cleaning up all water-sheds on short notice, or even of permanently maintaining this condition on long notice, are apparent, but the possibility of purifying all water supplies is a much more tangible proposition. Therefore, the method before mentioned promises the greatest sanitary efficiency, in the absence of sufficient funds to accomplish both results. It is not to be presumed that sewage purification should be abandoned, but rather that it should be a subsequent development, taking place when conditions would indicate that purification of the water supply was becoming a difficult problem, with reasonable possibility of failure.

As an eminent American engineer once said, "It is better to pay one dollar for water purification than ten dollars for sewage purification, when commensurate values are considered."

In the purification of water supplies, the question of pollution, studied in connection with modern laboratory reports thereon, might be classified under three heads:

Total Bacterial Pollution.—Considered on the basis of total bacterial content present, regardless of their identity.

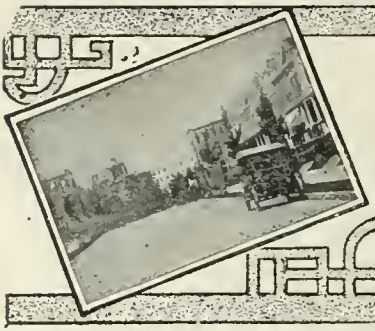
Sanitary Pollution.—May be outlined as the presence of bacteria or other organic matter foreign to water, without specific reference to the presence of pathogenic organisms and generally arrived at by the determination of B. Coli or some other specific organism. .

Pathogenic Pollution.—The presence of disease-producing organisms, the removal and destruction of which is the real function of water purification.

The methods of isolation and identification of pathogenic organisms by modern laboratory methods are entirely inadequate to meet the practical requirements of the case. The total bacterial count is of little or no diagnostic value, and it has become customary to determine what is therein designated as sanitary pollution by a general identification of some associate bacteria, which must arrive at their destination by the same routes as would be followed by the pathogenic or indicative disease-producing organisms. The presence of the colon group is assumed to indicate that the route of contamination is open. Modern practice tends more to the prevention of sanitary pollution than to the consideration of the total bacterial content of a given water. Studies apparently indicate that there is no necessary relation between total bacterial content and the B. coli content. However, a high degree of efficiency in decrease of bacterial content by a filter generally means a corresponding high reduction in coli content.

The establishment of arbitrary limitations to the satisfactory efficiency of water purification, measured and defined according to the coli content of the raw water, must always be considered and applied with reference to the special circumstances attendant on each case, especially if the attainment of that limiting coli content in raw water implies as a resultant conclusion therefrom, that sewage treatment on the water-shed has then become necessary, in conjunction with filtration, in order to secure a proper water.

There are large cities where the coli content of the raw water greatly exceeds 500 per 100 cubic centimeters; nevertheless, this water is successfully and satisfactorily treated by modern methods of filtration and sterilization. In fact, there are large sections of this country where raw water, coming within the limitations above defined, is not available, but which water, nevertheless, responds readily to modern treatment.



ROADS AND PAVEMENTS

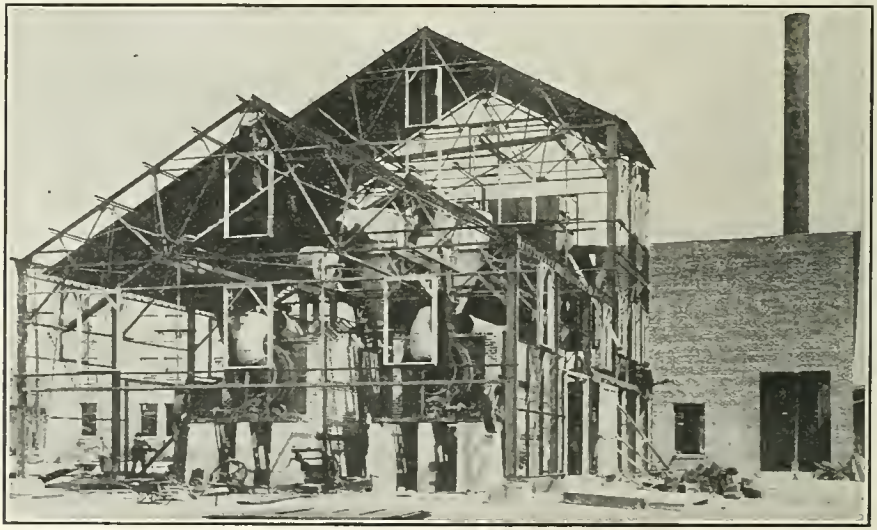
New Municipal Asphalt Plant at Pittsburg, Pa.

By Norman S. Sprague, Superintendent of Construction, Department of Public Works.

A new municipal asphalt plant, known as the North Side plant, has recently been completed and placed in operation in Pittsburgh, Pa. For some years asphalt resurfacing and repair work has been done by the city and recently the city adopted the policy of doing all asphalt paving work, with the exception of original improvements on streets paid for by assessment of property owners. Since the destruction of the old North Side plant by fire some years ago, the work has been handled by a single municipal plant located in the East End district of the city. The length of haul to the North Side district was excessive and this, together with the over-taxing of the capacity of the East End plant necessitated the construction of an additional plant, which is described herein.

The new plant is centrally located, with respect to that part of the city north of the Allegheny and Ohio rivers. The selection of the site was influenced by the desirability, on the score of economy, of having facilities for delivery of material both by river and by railroad. The site selected lies between the bank of the Ohio river and the tracks of the Pittsburgh & Western railroad, so that excellent facilities are afforded for the delivery of materials to the plant. Recently the city has adopted improved specifications for sheet asphalt paving, requiring a better sand grading and the mixture of fine sand imported from the lakes, to the extent of about 25 per cent. of the sand used. All materials, including the lake sand, will be delivered to the new plant by rail, except

PITTSBURG'S ASPHALT PLANT *for North Side, during construction, showing sand and stone dryers in place, and building under erection.*



PITTSBURG'S ASPHALT PLANT *for North Side, in operation. Sand and stone bins are seen above, discharging into mixers beneath them; tops of asphalt tanks in foreground.*

the local sand, which is dredged from the river in the vicinity of the city, and which will be received by barge.

The plant consists of a structural steel building housing driers, mixers and other equipment; a brick boiler and engine house; a switch track leading from the tracks of the Pittsburgh & Western railroad; a crane track, upon which is operated a locomotive crane with a 40-foot boom for the unloading of materials received by railroad; a dock on the river bank, where there is provision for a hoist of the locomotive crane type, with a 60-foot boom; storage bins from which materials for feeding the dryers are drawn. To date the plant has been completed with the exception of the dock, dock hoist and storage bins.

A contract for the plant was awarded under general specifications, accompanied by a plan of the site and a general arrangement drawing. The essential features of the specifications and contract were as follows:

(a) The contractor to design and build a plant in conformance with the specifications and general arrangement plan. Latitude was allowed the contractor with respect to general arrangement of plant and equipment, the contract providing that the contractor was not required to adopt the arrangement as shown in the general plan, provided an equivalent or better plan was devised and which would meet the general conditions of construction and operation. With regard to latitude in equipment and apparatus, the specifications stated the following:

"Bidders will be allowed sufficient latitude in submitting their designs and specifications for the various units of the plant, apparatus and appurtenances herein required so as to adapt their designs to the standard makes of such equipment, providing the requirements of these specifications are fully complied with and neither the efficiency or capacity of the plant are impaired in any manner."

(b) The capacity of the plant to be 2,000 square yards of completed asphalt pavement in a 10-hour working day, same to consist of wearing surface 2 inches in thickness and a binder 1 inch in thickness, or an equivalent of asphaltic concrete.

(c) The requirements as to the delivery of materials are stated and the contractor required to conform thereto.

(d) The specifications give the type, material, construction and capacity of the various units of the installation.

(e) The work excluded from the contract and which the city has done itself, includes the following: Grading of the site, excavation for foundation, concrete foundations for building and equipment, water, sewer and gas connections outside of building, paving of first floor of building and driveways, crane hoists, dock and bins outside of building, switch tracks and a few other minor exceptions.

The following are the principal features of the plant: A steel frame building, 88.5 by 42 feet, with corrugated sides and roof; a one-story brick boiler and engine house 30 by 30 feet; a 150-h.p. horizontal tubular boiler, fired with gas; 125-h.p. high speed automatic cut-off, self-contained steam engine; plant is belt-driven; there are two driers of the rotary type, brick encased, having a required capacity of 20 tons and a rated capacity of 25 tons each per hour of sand containing 7 per cent., or less, moisture; three melting kettles each with a capacity of 14 tons of asphalt; steam coils are electrically welded; two air compressors; asphalt discharge pipes and pressure tanks are steam jacketed; two 15-foot mixers and one 12,000-gallon flux tank with suitable coils.

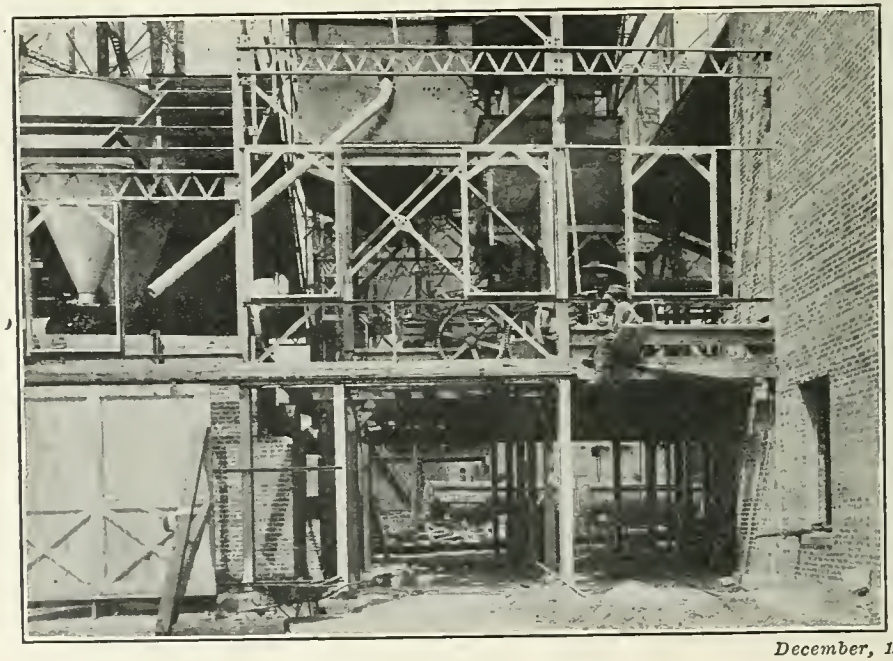
The material handling equipment includes two hot-material elevators, one for each drier; 2 hot-material bins with suitable partitions and each of 15 tons capacity; dust elevator, platform elevator, 350-gallon flux-weighing tank; four weighing buckets for sand, dust and stone, and two asphalt weighing buckets.

Flexibility in operation, which is highly desirable in a plant of this kind to meet demands from day to day, is obtained by the arrangement of driers, elevators, bins and chutes, which permits of operating either drier with either mixer. One of the driers is to be operated for the greater part of the time on binder stone and asphaltic concrete, while the other will be used principally for wearing surface. The system of chutes and by-passes, however, permits of the operation of both mixers on wearing surface when one of the bins is filled with materials for binder or asphaltic concrete.

The contract was formally awarded April 14, 1914, to the F. D. Cummer & Son Company, of Cleveland, Ohio, and the plant was completed and placed in operation September 25, 1914. The cost of the plant to date and the estimated cost when fully completed follows:

Contract for construction and equipment of plant	$28,900.00
Grading of site	4,000.00
Foundations, piers and sewer connection	1,000.00
Gas and water connections	425.78
Locomotive crane	4,850.00

PITTSBURG'S ASPHALT PLANT *for North Side, during construction. Bins for sand and stone above; mixers on second floor; driveways under mixers, where wagons receive their loads of asphalt mixture.*



PITTSBURG'S ASPHALT PLANT *for North Side, completed, looking south. Stone and sand storage in foreground with portable crane unloader. This is the same end shown in the first photograph.*

Switch and crane tracks.....	950.00
Total cost of completed work..	$40,125.78
Estimated cost of future work:	
Storage bins	$ 2,500.00
Dock	2,900.00
Dock hoist	5,500.00
Office building	2,000.00
Total	$12,900.00
Total estimated cost of plant when fully completed	$53,025.78

Plans are now under way for the construction of the proposed dock and holst at the river and for the storage bins. The latter will consist of three bins, each of 50 tons capacity, for the handling of broken stone, river sand and imported sand. The materials will be drawn from the bins in the correct proportions into a hopper car and pushed by hand to the bucket conveyors feeding the driers. This will make it possible to obtain exact proportioning of lake and river sand and thus insure uniformity of results.

The plant has been designed and erected under the supervision of Robert Swan, director of the department of public works, and N. S. Sprague, superintendent of the bureau of engineering, Tom M. Reed, division engineer, and James D. Strain, superintendent of asphalt plants.

Increase in Asphalt Production

Altho there was a decrease in the production of natural asphalt in the United States in 1913, including all the varieties of natural asphalt and asphaltic sandstone and limestone, there was a far greater corresponding increase in the output of manufactured or oil asphalt, according to the United States Geological Survey. Oil asphalt obtained as a residue from the distillation of Mexican, Gulf, and California asphaltic oils, and even from those of the Middle West, is becoming more and more available. There is correspondingly less interest in the development of new sources of natural asphalt.

The production of natural asphalt in 1913 amounted to 92,604 short tons, valued at $750,713, a decrease from 95,166 short tons, valued at $865,225, in 1912. On the other hand, the output of manufactured or oil asphalt in 1913 was 436,586 short tons, valued at $4,531,657, against 354,344 short tons in 1912, valued at $3,755,506. The total quantity of asphalt imported into the United States for consumption in 1913 was 228,178 short tons, valued at $910,611. The island of Trinidad furnished the greater part of this, 125,273 short tons.

Asphaltic Materials for Road Construction

By Alfred A. Berkowitz, Sheffield Scientific School, Yale University.

From a prize essay in the recent competition held by the Barber Asphalt Paving Co. the following extract is made, giving the points of major interest in its discussion of the selection of asphaltic materials for road construction.

To specify an asphalt by its chemical or its physical properties alone is not enough. The chemical properties of two asphalts might be the same, while physically they differed markedly. Moreover, a relationship exists among certain properties, and there is danger of assigning limitations to the several properties covered in a given specification without considering the effect of each limitation upon the other properties included. For instance, the higher the ductility required of an asphalt the more susceptible it is to change in temperature.

Furthermore, the engineer cannot be governed entirely by theoretical considerations, but must keep in mind the ability of the manufacturers to meet his requirements. He should avoid making requirements that are superfluous, inconsistent, unnecessarily increase the cost, or sometimes even impossible to carry out. Numerous instances can be cited where the combinations of properties required have not existed in any commercial material. These impossible requirements usually result when the engineer selects clauses here and there from several other specifications which he knows have given satisfaction.

With a view toward remedying this evil, the American Society of Civil Engineers, the American Society for Testing Materials, etc., have prepared standard specifications for asphaltic materials in various kinds of road construction. These specifications are very well drawn up and serve their purpose admirably, provided they are correctly and intelligently used. It is in this regard that experience can help us. In cases where these specifications have been used, nearly all the failures have been due to the fact that the specifications were followed blindly, without an understanding of their value and their interpretation; merely, as it were, substituting in a formula without considering the units involved.

A knowledge of the value and interpretation of each test must be possessed by every engineer who makes or who uses specifications before he can hope to obtain success in the employment of these very desirable materials. This is, in fact, the chief lesson of experience. Then, knowing these facts, and keeping in mind the lessons of service tests of similar materials under similar conditions, the engineer can employ specifications with the assurance that his work will be a success.

The value and interpretation of the more important tests required of asphaltic materials will be discussed.

The individual tests usually specified may be divided into three groups: (1) They may directly indicate the suitability of the material specified for a given use; (2) they may serve as a means of identifying the material or its source, and (3) they may serve to control uniformity in the preparation or manufacture of a material.

¶ SUITABILITY *of the asphalt for the required use is object of first group of tests.*

The most important test belonging to the first group is the determination of the consistency or viscosity. The consistency or viscosity of a material is its degree of firmness as determined by measuring its internal friction. Requiring this test in the specifications is of value, since a physical test can generally be better understood than any corresponding chemical one. This test, however, can be of maximum value only when applied to a specific type of asphaltic material and when considered in connection with other tests, which by themselves may not directly indicate suitability. Thus for one type of bituminous concrete pavement the proper penetration at 25 degrees C. for a California asphalt may be between 7 and 9 mm., while the proper penetration limits for a fluxed Bermudez asphalt to be used in exactly the same type of pavement and under the same conditions, may be from 14 to 16 mm. Again, experience has shown that a harder asphalt cement is needed for a sheet asphalt pavement of sand, powdered limestone and asphalt cement than for a pavement containing crushed stone. The amount of traffic and the climate are also important factors to be considered in fixing penetration limits for any asphaltic material.

Another test serving to indicate the suitability of a material for any special purpose is the volatilization test. A determination is made of the loss in weight of the material by volatilization, and of the consistency of the residue. It is of considerable value when applied to road oils. The loss in weight thus found is a fair indication of the loss by volatilization suffered by the material in the course of time when applied to the road, and also the character of the residue is similar to that eventually left in the road. The residue should be of a sticky nature. If the residues of these oils are not sticky

and adhesive they will produce an undesirable surface in wet weather. A paraffin oil will produce a greasy residue, and is, consequently, worthless for road work, whereas an asphaltic oil may be successfully used for this purpose.

¶ IDENTIFICATION *of source of asphalt is made by the second group of tests.*

The more important tests serving as a means of identifying the source of a material or even the material itself, are the specific gravity, melting point, solubility in carbon disulphid and fixed carbon determinations. The specific gravity of an asphaltic material is one of the most important characteristics used to determine its identity. This is especially true if its specific gravity is considered in connection with the consistency of the material, and sometimes its solubility in carbon disulphide. Thus a bituminous material with a specific gravity of 0.99 and a penetration of 7 mm. at 25 degrees C. is a blown product. Fluid consistency and a high specific gravity of 1.25 in a tar serves to identify it as a coal tar, and the identity is strengthened if its solubility in carbon disulphide is as low as 75 per cent. As applied to oil and oil products, the specific gravity roughly indicates the amount of heavy hydro-carbons which give body to the material. As a rule, paraffin oils have the lowest specific gravity and are of no value for road work, whereas asphaltic oils have the highest specific gravity and are most desirable for this purpose. In regard to solid bitumens as originally found, it must be remembered that the specific gravity will depend largely upon the per cent. of mineral matter. Thus the specific gravity of Trinidad asphalt (containing 37 per cent. of mineral matter) is 1.40, while Gilsonite, an extremely pure native bitumen, has specific gravity of 1.04.

The melting point of a bitumen is directly related to its hardness and brittleness, but the relations for all classes are not the same. The method of employing the material must also be considered in connection with its melting point. If the penetration method is used, the melting point should not be too high, because the highly heated material would be solidified by the cold stone before it had penetrated to any extent. In a bituminous concrete pavement, the melting point may be as high as climatic conditions will allow.

The determination of the solubility in carbon disulphide of an asphaltic material enables the amount and character of the contained bitumen to be ascertained. The percentage of bitumen thus obtained does not alone determine the value of an asphalt for paving purposes. Two asphalts might contain the same amounts of bitumen and yet possess entirely different powers of resistance to the destructive action of the elements. One might possess stability, the other not. The character of the bitumen does, however, indicate, by the amount of mineral matter present, whether an asphalt has been used. Likewise, an absence of mineral matter indicates that the material has been destructively distilled during its preparation.

The amount of fixed carbon in asphaltic material also serves to identify the source of a material. Thus high fixed carbon in most asphaltic cements produced from Mexican petroleums serves to differentiate them from asphalt cements of the same consistency produced from California petroleums. Consequently, if the amount of fixed carbon found in a California asphalt cement were as high as the amount usually present in Mexican asphalts (about 16 per cent.), the indication would be that it has been injured by overheating.

¶ CONTROL OF PREPARATION *and manufacture is secured by the third group of tests.*

The tests that serve to control the preparation and manufacture of a bituminous material are the flash point, distillation, and the solubility in naphtha tests. The temperature at which the material flashes is an indication of the treatment to which it has been subjected. Crude oils have a low flash point, while more highly distilled products have correspondingly higher flash points. The flash point of a material must be considered in connection with its proposed use. If the material, especially a heavy road oil, is to be heated before application, the flash point should be high enough to prevent its ignition while being heated.

The distillation test is a valuable one, especially for tars. No tar containing water should be employed as a permanent binder.

The extent of the solubility in naphtha is an indication of the amount of body-forming hydro-carbons which give mechanical stability to the material. No oil containing les sthan 4 per cent. of bitumen insoluble in naphtha will prove of service other than as a dust preventive.

To the valuable data that may be obtained in the manner described above must be added the lessons of experience and service tests of various asphaltic materials under various conditions and in

different types of roads and pavements.

The need of alleviating the dust nuisance has involved the use of asphaltic oils for that purpose. Experience has shown that the oils used should show some degree of adhesiveness when rubbed between the fingers. Their residues after the evaporation test should be decidedly sticky. If oily, they will act more as lubricants than as dust binders.

It must be emphasized again that paraffin oils are worthless for this purpose. Engineers thruout the country are finding that the use of palliatives for dust prevention is but a makeshift at the most, and that the best practice is tending toward the construction of bituminous surfaces or carpet coats wherever any degree of satisfaction and permanency is desired.

¶ BITUMINOUS SURFACES *protect and improve old wearing surfaces of other materials.*

Bituminous surfaces are used principally on macadam and gravel roads, on bituminous and cement concrete pavements, and to some extent on brick and stone pavements.

The character of the traffic to which the road is to be subjected should be considered in the construction of a surface. Experience has shown that if the road is subjected to light motor and light team traffic only, with the motor vehicles predominating, an asphaltic oil of such viscosity that it requires heating to at least 250 degrees F. before application forms a bituminous surface that withstands the traffic and thoroly preserves the road for a period of time depending upon the quality of the material and workmanship and upon the quantity of traffic.

The failure of many bituminous surfaces can be traced to improper preparation of the broken stone surface.

The adhesion of the oils to the stone is a very essential point to consider. Most engineers are in favor of applying the bituminous material under pressure since the adhesiou to the stone is much more satisfactory in this case. In order to get the best adhesion of asphaltic oils, the stone surface should be a little moist rather thau extremely dry, but in either case, every particle of dust and dirt should be removed from the stone by sweeping.

With proper construction and under normal traffic conditions, retreatment is necessary every one or two years. In choosing the bituminous material for a surface which will have to be renewed often, experience has shown that care must be taken to select a material which will set up sufficiently to allow the application of repeated layers without producing a plastic, easily moved blanket surface.

Properly constructed, bituminous surfaces are quiet, practically dustless, and comfortable to use.

With the advent of the motor car, it was found that the water-bound macadam pavement did not stand the automobile traffic and that bituminous macadam could be laid to withstand this traffic at a cost equal to water-bound macadam, when the maintenance of the latter is considered. The bituminous material used may be either asphaltic cement or refined coal tar. The former is preferable because it possesses greater stability under atmospheric action.

Here again, numerous instances can be found where unsuitable materials have been employed thru the failure of the engineer to understand the physical and chemical properties of the different types of asphaltic materials, and the different methods of treating them. For example, many a good asphalt has been ruined by overheating. Again, asphalts of too little ductility have been chosen.

The slight displacement of the mineral aggregate of a pavement due to the shocks of hoofs or wheels makes it necessary that the asphalt cementing material should yield and stretch a little and not break. On the other hand, the greater the ductility, the more susceptible is the asphaltic material to changes in temperature. Once more the knowledge of the relationship among the various properties of a material enables the engineer to intelligently set the limits in his specifications.

¶ EXPERIMENTAL SECTIONS OF ROAD *under different amounts of traffic demonstrate the qualities of bituminous surfaces of various kinds.*

A series of experimental sections was constructed on a road subjected to mixed traffic of about 100 horse-drawn vehicles and from 250 to 300 motor cars per day. These sections were constructed with asphalt, refined water gas and coal tars, and combinations of refined coal tars and asphalts, in the form of bituminous concrete pavements, using the same material for the cement and the seal coat. Upon examination after three years, it was found that for this class of traffic, or for horse-drawn traffic exclusively, the seal coat should consist of an asphalt, as being more durable and economical than the other materials.

Experience in another locality has shown that an excess of flux or of the volatile constituents in asphalt cements has been a cause of failure. Pavements constructed with such materials are wavy and distorted by heavy traffic.

One of the most widely used pavements is sheet asphalt. Trinidad asphalt was for many years the only available supply of such material, but in recent times many other sources have been disclosed.

In addition to the native asphalts, like those obtained from Trinidad and Bermudez, asphalts are obtained by refining asphaltic oils. The results of experience and service tests in this kind of pavement alone furnish the engineer with a collection of valuable data. The selection of both the aggregate and the asphalt cement requires a careful understanding of the climate, traffic and other conditions. Proper drainage, in this, as in all other pavements, is a primary requisite. Furthermore, certain bitumens require more skill in handling than others. Again, some require particular fluxing agents and result in failures when improper ones are used.

¶ REQUIREMENTS OF ASPHALT PAVEMENT *include inherent stability, proper fineness of material, proper consistency of asphalt.*

The main requisite of a good sheet asphalt pavement is inherent stability. This can only be obtained if the mineral aggregate is properly selected and if the bitumen possesses cementing value. Experience has shown that the heavier the traffic to which the pavement will be subjected, the finer must be the particles composing the mineral aggregate. In addition, the consistency of the asphalt cement must be of the right degree, that is, the newly laid pavement should not be too hard. The marking up of a pavement by the calks on horses' shoes does not necessarily indicate that the pavement has been improperly constructed. If the pavement were too hard at the start it would have a shorter life than if a softer asphalt cement had been used.

Sheet asphalt pavements properly constructed with native asphalts, either from Trinidad or Bermudez, have given the highest degree of satisfaction. The Barber Asphalt Paving Company recently took a census of the old asphalt pavements. In New York City there are 184,290 square yards of Trinidad sheet asphalt 20 years old or older. A part of this is on Fifth Avenue and is subjected to the very heaviest traffic. The remainder is also subjected to heavy travel, yet all the pavements are in very good condition at the present time. Washington, D. C., has more than 1,000,000 square yards of Trinidad sheet asphalt pavement laid between 1877 and 1901. The average cost of maintenance is 1.8c per square yard per year.

Recut Granite Block Pavements

Condensed from a Paper by William A. Howell, Engineer of Streets and Highways of Newark, N. J., before the American Society of Municipal Improvements.

Until recent years old granite block pavements were not supposed to have any great commercial value, there being no regular demand for this form of paving material. In May, 1911, our city (Newark, N. J.) received bids for paving a very important thorofare, Market street, with smooth pavement, and provided that the old granite blocks should be removed and become the property of the contractor and that he should make allowance for these blocks in his bid for the new smooth pavement of another kind. The amount of granite blocks was about 23,500 square yards. The bidder was not particularly pleased, because he expected to have the old blocks on his hands for about ten years. A market for them after recutting began in 1913 in Kearney, mentioned below. During 1914 Newark replaced 75,500 square yards of old granite block pavement on Broad street with wood block pavement. The number of old blocks aggregated 1,085,000, of which about 85 per cent. could be recut and used on other streets. Newark is selling these blocks to contractors to be recut, napped and used for new pavements, at $30 per thousand blocks. These blocks represent an asset to the city of about $31,000. A very tidy sum for the street repair fund. Further detailed mention of use of recut blocks in Newark is found below.

The writer asked an important granite block manufacturer of Maine in 1909: "To what use can old granite blocks be put?" He answered: "They could be cut in two (called napped), reclipped and would practically make a new pavement."

¶ RECUT GRANITE BLOCKS *were first laid in Bronx Boro, New York City, in* 1909.

The first street known to the writer where recut granite blocks were used is Webster avenue, Bronx Boro, New York City, in 1909. The old blocks were 7 to 8 inches deep and in fair condition, having originally come from Long Cove, Me.; Cape Ann, Mass., etc. The specifications for the recut blocks required them to be 6 to 12 inches long, 3½ to 4½ inches wide, 5½ to 6½ inches deep. Where some blocks ran up to 5 inches wide they were allowed to be used, provided the entire course had the same width. The price for Webster avenue was $1.27 per square yard

for paving and 55 cents per square yard for concrete foundation 5 inches thick, total $1.82 per square yard. The joints were filled with portland cement grout. This pavement is in first-class condition today. Since then, Bronx Boro has laid thousands of yards of this form of pavement. The old blocks were simply cut thru into smaller sizes, squared up to give a joint not exceeding ¾ of an inch. The price paid for recutting in 1909 was $10 per thousand blocks.

In Philadelphia, William H. Connell, chief engineer of highways, informed the writer they have one street laid with reclipped and grouted old granite blocks, 10,546 square yards of Broad street, between Cumberland street and Silver street. The old granite blocks were taken up, reclipped and relaid on the street in June, 1913, at a cost of $1.43 per square yard, including sand cushion. The old concrete foundation remained and was used. The specifications required blocks to be redressed to 5 to 6 inches deep, 5 to 7 inches long, 3½ to 5 inches wide.

Mr. Connell states: "The laying of this kind of pavement is very economical and it equals in smoothness and appearance the latest and best type of construction of granite block paving." The writer inspected this street in July, 1914, and was pleased with its appearance. The heads of the blocks are remarkably smooth and the joints appear closer than could be obtained on the majority of streets laid with new granite blocks.

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¶ RECUT GRANITE BLOCKS *were used in Troy, N. Y., at a material reduction in cost.*

Troy, N. Y., City Engineer A. E. Roche, writes: "During the past year Troy has gone into the splitting and quartering of its old granite block pavements and relaying them on quite an extensive basis. The blocks had been in use 30 or 40 years and were Rockport granite 9 to 14 inches long, 5 to 6 wide, 7 to 8 deep, rounded on the surface and very uneven. The blocks were halved and quartered (napped and reclipped, as it is called in Newark). The contractor took up the old blocks, removed them to any plot of ground he could hire, made them into new blocks 7 to 9 inches long, 4 to 5 inches wide, 4 to 5 inches deep. He then graded the street, laid the concrete foundation, spread a sand cushion, laid the blocks and filled the joints with portland cement grout. Attention was given to the necessity of alwas having the new face of blocks uppermost. The price was $2.30 per square yard, including excavation, concrete foundation and five years' maintenance and guarantee.

"Troy required the contractor to recut all the old granite blocks, altho an excess of about 25 per cent. of first-class blocks would be obtained over and above those required. The city allowed the contractor $15 per thousand for those delivered at such points within one-half mile, as the city engineer directed. Troy expended in 1914 for recut block pavements $62,000. That city previously paid an average price of $3.85 per square yard for close jointed Concord (N. H.) new granite block pavements. Troy expects next year to lay 22,000 square yards of recut old granite blocks by halving and quartering them, rather than discard the old for the new ones."

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¶ BROOKLYN AND MANHATTAN *boros of New York have used recut granite blocks with success and economy.*

Brooklyn, N. Y., Chief Engineer of Highways H. H. Schmidt states: "We have not used what is commonly known as napped blocks, but have paved a number of streets with recut granite blocks made from the old large stones by redressing them to the regular specification size. He gives a list of six streets, comprising 29,965 square yards, which cost, including recutting, supplying a 6-inch concrete foundation, etc., an average of $3.65 per square yard.

Manhattan Boro, New York, Chief Engineer W. H. Durham states that until recently no reclipped granite blocks were used in Manhattan, but that a contract has just been completed on Avenue A from 54th to 57th street, about 5,500 sq. yds., using the old blocks on the street. They are broken in two and laid with the fractured side as the new head and upon 1 inch of sand cushion; of this 1,830 square yards were filled with tar filler and 3,670 square yards with cement grout for purposes of comparison. The cost for wearing surface was $1.45 per square yard and 55 cents for concrete foundation; total $2. The old blocks in this case furnished material for only 60 per cent of the area, the remainder having to be supplied with new material by the contractor.

Trenton, N. J., has recently laid 3,500 square yards of this form of pavement, using cement grout for filler. The old blocks were furnished by the city and the price on 5-inch concrete foundation was $1.58 per square yard.

The credit of introducing this form of pavement belongs to Bronx Boro, New York City, where Mr. R. H. Gillespie, chief engineer of sewers and highways,

has furnished the writer valuable information and a long list of streets thus paved, at an average cost for 213,341 square yards of $1.72 per square yard, including 5-inch concrete foundation. This was for pavements laid from 1909 to 1914. The average cost up to November, 1913, for all streets thus paved, 267,150 square yards, or about 8 miles, was about $1.68 per square yard for recut old granite block on a 5-inch concrete foundation, compared with an average of about $3.67 per square yard for new granite block on same foundation. A considerable portion of the old blocks ran from 12 to 14 inches in length and 7 inches depth. The blocks were split, broken in two and dressed so as to lay ½-inch joints. The finished blocks are from 6½ to 8 inches long, 3½ to 4¼ inches wide, 5½ to 6½ inches deep. Blocks less than 11 inches long are reheaded when necessary and dressed and as a rule used along railway tracks. The splitting and dressing is done on the street by stone cutters, who receive about 1½ cents per redressed block, or $15 per thousand; each man getting out from 450 to 600 blocks per 8-hour day. He earns about $7.75 per day, depending partly on his skill and speed and partly on the character of the granite and condition of the old blocks. The blocks when dressed are piled along the sidewalk until the concrete foundation is ready for the pavement. They are laid in the usual manner in rows at right angles to the curb line and on a 6-inch, 1-3-6 concrete foundation and 1½-inch sand cushion. The pavement alone, exclusive of concrete foundation, costs an average of $1.21 per square yard as compared with an average cost of $3.20 of new improved granite block, exclusive of foundation.

¶ RESULTS IN ALBANY, N. Y., *with recut granite blocks have been equally satisfactory.*

Albany, N. Y., City Engineer F. R. Lanagan, states that Albany is taking up old granite blocks in 1913 and 1914 on many streets, breaking them in half, redressing when necessary, relaying with the new surface upon a 6-inch, 1-3-6 concrete foundation and grouting the joints with 1 to 1 portland cement grout. Old blocks there vary in size and form so that from many old blocks but one new block can be obtained, but generally there is a surplus from a given area. The price per square yard includes taking up old blocks, breaking and redressing into new blocks, 6-inch concrete foundation, sand cushion 1½ inches, laying, ramming, grouting and five years' maintenance. The average price of a list of six streets given, for 32,800 square yards, was $2.35 per square yard. The size of the recut blocks is not less than 6 inches in length, 3½ to 4½ inches wide, 5 to 6 inches deep. Soft, brittle or laminated stone is rejected. The city supplies the number of old granite blocks needed to be recut and used as stated by the contractor, who, however, does the carting.

¶ NEW JERSEY CITIES *have followed the practice of using recut granite blocks with satisfaction.*

Kearney, N. J., during 1913, paved Tappan street, between Davis street and Chestnut street, with napped and redressed old granite paving blocks, which had been removed from Market street, Newark, N. J., nearby. The area was 3,278 square yards at a contract price, including 6-inch concrete foundation, of $2.48 per square yard.

Newark, N. J., made its first attempt to pave with napped and reclipped old granite blocks on Meeker avenue, from Frelinghuysen avenue to Western avenue. The contractor did not pay enough to get good results, and his old blocks came from different streets representing original output of different quarries. After much patience, the pavement was finally accepted. During 1914 contracts were made for this kind of paving for six streets, covering 26,900 square yards, at a cost of $94,337, or $3.50 per square yard, which includes concrete foundation, sand cushion, cost of purchase, recutting, laying the blocks and grouting the joints. The city, however, had received from the contractor the price he paid the city for the old granite blocks at $30 a thousand, representing about 60 cents per square yard. A portion of these pavements have been completed and give general satisfaction. The contractors have at their command the granite blocks from the old Broad street pavement, which, during 1914, was being replaced with wood block pavement. The smooth heads of these recut granite blocks and the close joints are very noticeable, even to an ordinary observer. From Washington street to High street, between William street and Clinton avenue, are a number of streets which until recently were paved with cobblestones. Of these streets referred to, Spruce street, Crawford street and East Kinney street have been paved with new grouted granite bolcks, while Baldwin street, Longworth street and Court street have been paved with napped or recut and reclipped old granite blocks; which three pavements compared very favorably with the first three and cost

about 60 cents per square yard less. Newark has under consideration the repaving of three very important streets with recut granite blocks, the intention being to use as much of the old granite paving material now on those streets as conditions will warrant. The streets referred to are Ferry street, from Market street to Lantz avenue, 21,000 square yards; Washington street, from Market street to Central avenue, 6,400 square yards; Plane street, from Market street to State street, 14,800 square yards; the estimated cost being $128,600, an average of $3.49 per square yard for everything, including concrete foundation. Because a bond issue is contemplated, it is doubtful if at this time these pavements will be laid.

The old granite blocks in Newark, used during 1914 for recutting and paving, range from 10 to 14 inches long.

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¶ ESTIMATES OF COST *show the reasons for the less cost of the recut granite block pavements.*

A block maker in a day's work of eight hours can nap or cut thru and reclip or redress 175 of the large old blocks into 350 new small blocks. It costs the contractor to do this, $12.50 per thousand for small blocks produced, i. e. $25 per thousand of the large old blocks used. The large old blocks run twenty-one and recut into small new blocks forty-two per square yard. A rough detailed estimate of the cost in Newark of this kind of pavement, with a variation of possibly 10 to 15 cents, would be about as follows per square yard:

Twenty-one old blocks per square yard paid city at 3c each	$ .63
Paid stone cutters (per thousand finished $25)	.53
Hauling	.10
Handling and laying	.20
Grouting	.12
Sand cushion	.05
Concrete foundation, 6-inch	.65
Grading	.10
Total	$2.38

A list of eleven streets is given, for which contracts were awarded during 1913 and 1914, at an average payment to the contractor, including everything, of $3.36 per square yard.

The only difference in the specifications in Newark for new and recut granite block pavements is the dimensions of the recut blocks, which shall be not less than 6 nor more than 12 inches long, instead of not less than 8 nor more than 12 inches for new blocks from quarries.

As to the financial saving effected by the use of recut and napped or redressed blocks in Newark, with prevailing prices, the assessment on the property owner on a 36-foot wide street, using new granite and new curb, would be about $8 per foot front, or $200 for a 25-foot lot. If napped and reclipped, that is recut old granite blocks are used (the old blocks being sold at $30 per 1,000 to the contractor by the city), the probable cost per foot of assessment to the property owner would be $6.35 per front foot, or $158.75 per 25-foot lot, with old blocks obtained from other streets. But if the old paving blocks on the street are taken up, napped and redressed and used in replacing that pavement, a still greater saving can be effected; so that the estimated cost per foot front would be $4.75, or $125 per 25-foot lot.

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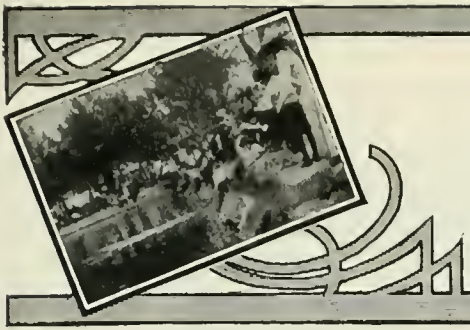
¶ DURABILITY *has always been an essential in pavements with heavy traffic, and now granite block pavements can be reduced in cost and roughness without loss of durability.*

Twenty-five or thirty years ago, when paving of important thorofares was under consideration, the main point influencing municipal authorities, aside from the cost, was the question of durability. This explains the presence of granite pavements on many streets of cities where other paving materials would have been selected if they had been known to possess equal durability. Few pavements were laid on a concrete foundation previous to 1890, and the entirely unnecessary thickness or depth of 7, 8 and 9 inches of granite blocks was to a certain degree excusable. After the general adoption of concrete base under granite pavements, it required nearly twenty years' constant agitation to reduce the thickness of the blocks to the reasonable standards of the present day. Some cities have reduced the thickness to 4 inches.

The main object of this paper is to awaken interest in this form of pavement, which affords a chance to lay a durable and practically new pavement at a very low cost. Any town or village having any old-time granite pavements, laid either on sand or concrete foundation, is in a position to get a new pavement at minimum cost. A granite pavement which has given twenty-five years' service may give an additional service of twenty-five years under the methods described in this paper, which would put granite as a paving material in the first place as far as durability is concerned.



Municipal Notes

Apparatus for Detecting Smoking Chimneys on Trial

It has long been recognized that careful manipulation of the fires under the boiler will reduce the smoke problem at least 50 per cent. The trouble has usually been due to the top of the stack being out of sight of the fireman. Professor W. W. Strong, during his investigation of the smoke problem for the Pittsburgh University, recognizing this fact, has designed an electrical apparatus that will not only indicate when the stack is smoking, but also record the number of minutes that it smokes. One of these devices has been placed by the Smoke Abatement Commission of Baltimore, Md., at the power plant connected with the Mt. Claire shops of the Baltimore & Ohio railroad.

The apparatus is essentially an electrical device and its action depends upon the state of ionisation of the flue gases.

Accompanied by proper direction as to how firing should be done, this apparatus should help materially in the work of smoke abatement.

Municipal Improvements in Peru

The following discussion of the public health situation in Peru is condensed from a recent issue of *Peru Today*:

Peru has paid serious attention during the past decade to the water supply and drainage of her principal towns, and is continually authorizing new studies and installations. The work is carried on under the immediate direction of the Section of Public Health of the Ministry of Public Works and Development. The sanitary laws in force are based on English practice, with certain modifications to adapt them to the customs of the people.

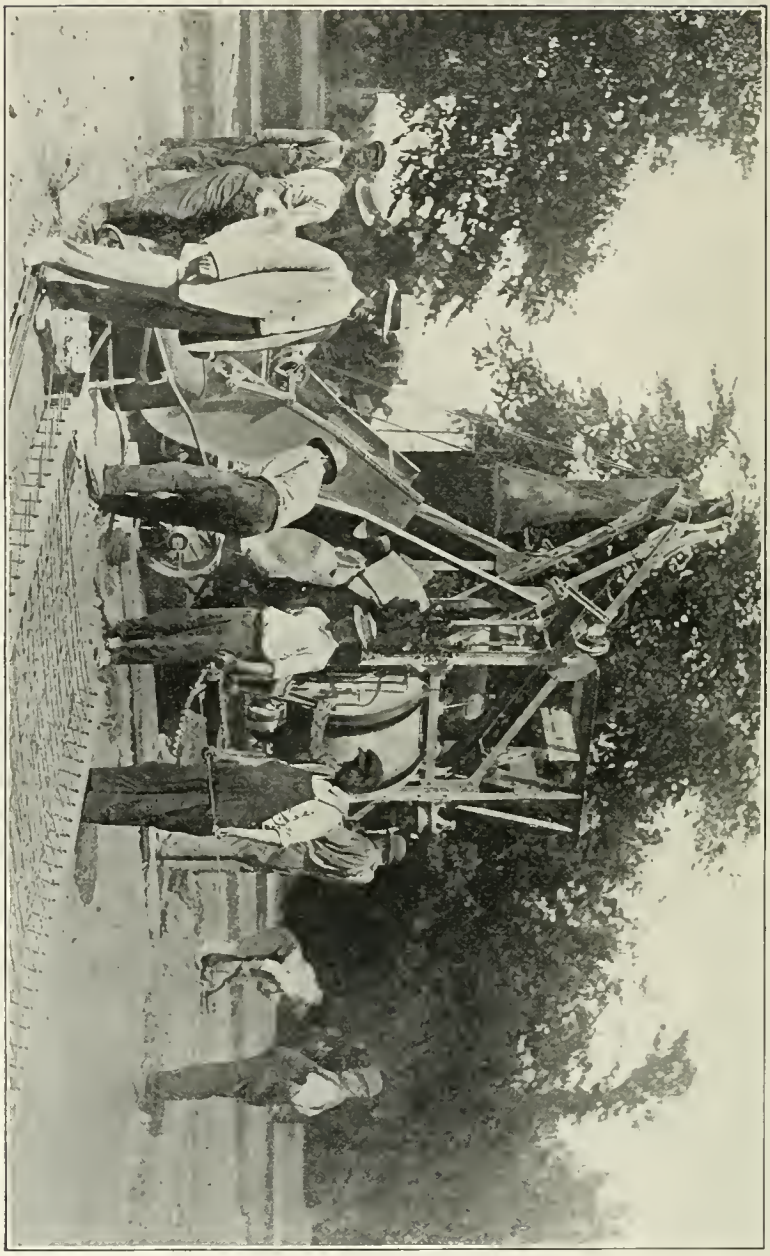
The government has taken in hand the matter of providing an improved water supply for the Lima district, including Lima and the neighboring seaside resorts of Chorrillos, Barranco, Miraflores, Magdalena, and possibly Callao. In the last-named city water and drainage works are now nearing completion. The sewerage system of Callao divides the town into three zones, with the sea outfalls located where the current carries all sewage away promptly. Two of the zones utilize the ejector system of automatic compressed-air lift, while the third is entirely a gravity system. The water works for Callao, which has a population at present of 34,436, will provide a daily supply of nearly 4,000,000 gallons.

At Arequipa, the second city of Peru, the water works capacity is to be increased to 2,377,000 gallons per day, at a cost of $263,000, and the drainage system is to be extended. Water is now brought into the town of Trujillo, but is not distributed to the houses. The plans provide for a supply of about 660,400 gallons per day, with a filtration plant and a system of distributing mains. Similar improvements are planned for many of the smaller towns and summer resorts.

Reinforced Concrete Pavement Foundation Over Trench

The accompanying photograph shows a method of replacing pavement foundations over trenches cut thru for sewers or other public utility pipes, lines or conduits in use in St. Paul, Minn., where Oscar Claussen is chief engineer.

It will be seen that rods less than 1 inch in diameter are used, set about 6 inches apart across the trench and 8 to 12 inches apart longitudinally. The transverse rods are held in place while the concrete is being laid by means of the boards shown, which have holes bored in them about 1 inch in diameter, which hold the rods in place. As soon as the concrete is in place sufficiently to hold the rods the boards are lifted out, the slots allowing them to pass the rods, and they are then ready to use in the next length of trench. The reinforcing rods cost about $2.30 per 100 pounds, delivered on the street. Handling and setting place cost less than 1 cent a pound. J. E. Carroll, assistant city engineer, has furnished the data and the cut.



LAYING REINFORCED CONCRETE *over trench cut in street pavement. Note method of keeping reinforcement in place while laying concrete.*

Pasadena's Municipal Electric Plant Has Saved Consumers $731,083

The operation of the municipal lighting plant in Pasadena has broken all records for economy, according to the annual report. Among other things, it says: "The saving resulting to the people of Pasadena from October 1, 1908, to June 30, 1913, by reason of the difference in rates charged before the city entered the light and power business and the rates charged our neighboring cities since, amounts to $557,583.90, plus the saving for the past year of $174,000, making a total saving of $731,083.96. The rate was 15c per k.w. hour when the city began talking about a municipal plant. Then it dropped to 12½ cents, while the plant was being built. When the rate was lowered to meet the 8-cent rate established by the city, the 12½-cent rate was continued in force in other southern California cities by our pompetitor. Subsequently the base rate in some of the other cities was reduced to 10 cents, and so remained until January, 1913, when a rate of 8 cents was established. On April 1, 1914, a base rate of 7 cents was made by the city's competitor in various other cities. However, this is considerably higher when compared with the rate of 5 cents charged by Pasadena's municipal plant."

Dismissal of Employes Under Civil Service

The problem of determining when a man should be dismissed from a service based on merit without suspicion of bias or prejudice is a different one. Under some systems of civil service rules the commissioner in charge of the department is the sole judge of the propriety of discharging a man. In others the man can appeal to the Civil Service Board.

In the Boro of Manhattan, New York, President Marks has established a joint board made up of two fellow employes chosen by lot and two officials, commissioner or superintendent to advise him as to the disposition of a case.

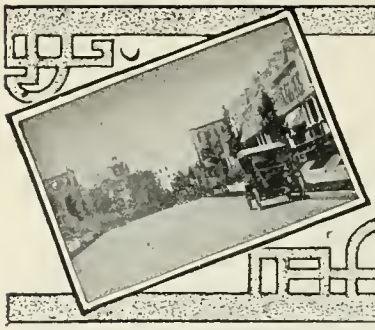
In the first cases under the new plan the charges were preferred, before a board constituted as above, by the head of the bureau in which the man complained of was employed. After various questions had been asked and answered of the man and the bureau head, all retired but the board and the man's dismissal was recommended. The second case, in which the charge was repeated intoxication during working hours with a plea of guilty and request for leniency, removal was recommended.

President Marks states that his previous experience has been similar in that recommendations by fellow employes as to dismissal or retention are based on the utmost sense of fairness and justice.

Zone of Quiet Signs

Motorists have noted how even some of the smallest villages having hospitals, sanitariums and the like, are mounting "zone of quiet" signs at the roadsides, as an unspoken request to the automobilist that he not only moderate his speed with the attendant roar, but also refrain from useless soundings of klaxon or other horn. So effective have these signs become and so welcome the relief brought by them that communities are eager to erect the sign-posts on their highways; and auto supply dealers and the like find that a morning can be made quite profitable by speeding forth to communities not already provided and soliciting orders for such sentinels of the road.

The photograph shows a sign of the sort, of rather artistic arrangement, as set up near the various hospitals and infirmaries by the city government of Cincinnati. The lettering is in two colors put behind a pane of glass, with an iridescent background.



MISCELLANEOUS

Road Congress of the American Highway Association

The Atlanta Road Congress held the week of November 9 registered over 3,300 attendants, including local attendance of the first day only. Over 100 exhibitors crowded the auditorium, two city blocks in a temporary structure, and two blocks under a convenient viaduct. Many excellent papers were presented, abstracts from some of which appear in this number of MUNICIPAL ENGINEERING and will appear in later numbers.

Among the resolutions adopted by the congress were the following:

Resolved, That the American Road Congress emphatically endorses the principle of federal co-operation toward the construction of main highways and thus assist the several states to build the main market roads on the one-half of the country which is devoted to agriculture and to build thru main roads in the one-half of the country which is not predominantly agricultural, but whose prosperity depends upon mining, the raising of live stock and the presence of the health seeker and tourist.

Whereas, the American Road Congress believes in and has long urged all states to enact uniform road legislation, and,

Whereas, experience has abundantly demonstrated that efficiency and economy are not obtained in the construction and upkeep of main roads, except by the co-operation of the states thru skilled departments, and,

Whereas, forty of the forty-eight states have enacted state legislation, Georgia, Indiana, North Carolina, South Carolina, Tennessee, Arkansas, Florida and Texas being the exceptions, and,

Whereas, Federal aid and co-operation are near at hand, and it is probable that states having no highway departments will be unable to participate in such aid, therefore be it

Resolved, That the American Road Con-Congress in annual convention assembled in the city of Atlanta, embracing several thousand delegates, representing every state, reaffirm its belief that state road departments and state aid are essential to secure efficiency and economy;

Resolved, That the Lincoln Highway Association be commended for its successful voluntary effort in arranging with counties, cities and townships for a connected series of roads across the United States, thus providing a definite and continuous route to be used wholly or in part by those who wish to become acquainted with the agricultural, mining and scenic advantages of their own land;

Resolved, That the American Road Congress deplores the frequent accidents on the public highways and urges upon the various highway officials or other authorities thruout the United States the enactment of the necessary rules and regulations to insure the public safety;

Resolved, That the federal government be urged to build highways across all Indian and forest reservations and all other federalized areas, where such connectiug links are essential parts of established thru routes of travel.

Government Exhibit at American Road Congress

The Office of Public Roads of the United States Department of Agriculture displayed at Atlanta, Ga., during the fourth American Road Congress, November 9-13, a complete set of models illustrating the construction and maintenance of standard types of roads. The models were so arranged as to present the historical and technical development of road building. Thus a set of models showed the evolution of stone road building for a period of 2,000 years, including the Appian Way, as representing the Roman type of construction; the early French roads during the reign of Napoleon I, the Telford and early macadam roads built in England during the reign of George IV, and macadam roads as they are constructed today.

One of the models illustrated the characteristic features of road construction in

the Swiss Alps; another the best practice in this country of road location and relocation. In the latter model is shown an old earth road, with characteristic features, such as steep grades, bad alinement, dangerous grade crossing, unsafe wooden bridge, poor location, inadequate drainage, dilapidated farm buildings and the old district school house, with unsightly and unsanitary surroundings. In the same model was shown the new road, located on high ground on side hill slopes, with easy grades, pleasing and practical alinement, with grade crossing eliminated, permanent culvert and bridge, good drainage, a well constructed and maintained macadam surface, sightly farm buildings and attractive consolidated district school house, supplied with pure water by means of windmill and reservoir.

The most approved methods of subdrainage for roads which pass over soft or unstable ground were shown by a model which represented the V-drain, the Telford base and the French drain. Models showing details of construction and important stages in the building of a reinforced concrete culvert and a concrete bridge of the incased steel I-beam type were also included.

Three of the models illustrated the construction of earth, sand-clay and gravel roads. Miniature mechanical models in actual operation showed the quarrying and crushing of stone and the use of a power roller working on a macadam road.

Since the coming of the automobile, with the consequent aggravation of the dust nuisance, numerous methods have been devised to secure lasting and dustless road surfaces. The most important of the types thus developed, aside from the paved roads adapted to heavy traffic, such as asphalt block, brick and concrete, of which appropriate models were included, are generally classed as bituminous construction. These types have been largely developed during the past few years, and were represented in the exhibit by the following models: Surface treatment of new macadam road, resurface of old macadam road by the penetration method, penetration method, mixing method, mixed filler method, rock asphalt and Topeka specification.

All the models were built to the scale of 1 inch to the foot, or one-twelfth of the full size.

An automatic projectoscope presented a large number of self-reading lantern slides, showing road scenes in many parts of the United States.

Several sets of motion picture films, representing construction scenes on the post roads now being built by the Office of Public Roads in co-operation with the Postoffice Department, and the various States, were shown.

American Cement Confiscated in Egypt

A carload of white portland cement, shipped by the Sandusky Portland Cement Co. to a German citizen resident in Jerusalem, before the European war began, seems to have been confiscated by the British authorities in Egypt as contraband of war. The cement company has protested to the Department of State that this is an attack on private property which is not authorized.

Four smaller shipments to India have not been delivered, at least one being on a steamer now in a Spanish port, where it cannot be unloaded and is likely to stay until after the war is over.

Literature on Petroleum

The United States Bureau of Mines has begun the collection of a general library of petroleum literature, under the direction of W. A. Williams, chief petroleum technologist. The details of this work have been assigned to Dr. David T. Day, who has recently been transferred from the United States Geological Survey as petroleum technologist, and who will assist in a thoroly organized research into the chemistry of oils, which is being developed by the Bureau of Mines. The importance of such a library is so manifest that it is hoped all technologists will aid in the work by exchanging with the bureau all available books and maps on this subject.

The San Diego Exposition

San Diego was the first city to charter an exposition in celebration of the opening of the Panama Canal, in which, naturally, it is vitally interested, owing to its location as the first port of call north of the isthmus. When San Francisco, six hundred miles to the north, chartered another exposition, San Diego put away its program of holding a world's fair of the old type, such as Chicago and St. Louis had held, and began reaching out for new ideas. The architecture itself is new, insofar as exposition work is concerned, altho in reality it is a renaissance of the old Spanish art and architecture which was flourishing in the southwest two and three centuries ago. Some of the finest relics in southern California are the old Spanish missions, and they, with the palaces and cathedrals of old Mexico, serve as models for the renaissance. The design is peculiarly appropriate in a country whose most romantic traditions are those of the Spanish occupation and

THE PRADO *in the Panama-California Exposition Grounds at San Diego, California.*

settlement, and whose natural landscape is such as to be set off best by the Spanish type of building.

A most imposing view it is to look down to the strand of Coronado, Fort Rosencrans, and the great sea, less than a mile away from the Exposition Beautiful; and back up the valleys over orchards or orange and olive, over broad vineyards, to the snow-capped Sierras of California and the low hills of Mexico, scarcely twenty miles away.

In the immediate foreground the buildings are covered with the rich floral growth of southern California, with clambering rose and geranium, with honeysuckle and the blazing bougainvillea. The streets are lined with trees and shrubs, with guards and attendants in the costumes of old Spain. The harmony of sea and sky and mountain and valley, the quaint buildings and the abundant foliage, are an impressive restoration of the days of romance.

The accompanying photograph shows the Prado, as seen from the Ethnology building, and illustrates the description given. We are indebted for it to the Seagrave Company, of Columbus, O., who supply the fire protection apparatus for the buildings. The photograph is copyrighted by the Panama-California Exposition.

Prizes for Essays on Highway Construction

Students of the leading engineering schools have been offered an opportunity to compete for $1,000 in prizes on essays on highway construction. The subjects suggested cover a wide range, including factors which should govern the choice of types of pavements and roads and the materials used therein, an ideal paving program for a city of 25,000, economics of highway construction, and half a dozen related topics. The prizes are offered by the Barber Asphalt Paving Company to promote investigation of highway problems by engineering students and to encourage them to enter a field of work where there is great need for trained men.

Technical Associations

The next meeting of the National Fire Protection Association will be held in New York May 11-13, 1915. The year book of the association contains a list of officers and committees and of over 3,000 members, active and associate.

The International Engineering Congress to be held in connection with the Panama-Pacific Exposition, will meet September 20-25, 1915, in the new municipal auditorium building in the civic center of San Francisco. Some 220 papers are already provided for and it is expected that 300 or more papers and formal discussions by eminent engineers from all parts of the world will appear in the transactions. These will be published for subscribers. Membership in the congress costs $5 and entitles the holder to the volume of proceedings and to any one of the ten volumes of transactions desired. All the volumes can be obtained on reasonable terms. Subscriptions to membership should be sent promptly to the committee of management, W. A. Cattell, secretary and treasurer, Foxcroft building, San Francisco, Cal.

A convention of Alabama city officials has been called by the College of Engineering of the University of Alabama, for the purpose of organizing a state league of municipalities. The convention will be held in Tuscaloosa on December 3 and 4. The proposition is meeting with an enthusiastic response.

On November 11 the New York Electrical Society heard a paper by W. M. Johnson on "Electric Furnace Loads for Hydro-Electric Plants," which discussed the relative economic value of electricity and coke or coal for smelting ores and refining metals, tho an electrically generated calorie costs more than a carbon-generated calorie.

The New York Peace Society has provided a series of lectures for December 10, January 28, February 25 and March 25, the first by John Barrett Moore on "Past and Present Relations of the United States to the American Republics"; the second by Senator Theodore E. Burton on "Industrial and Commercial Effects of the Panama Canal and Their Influence on World Relations"; the third by Secretary William J. Bryan on "Possibilities of Friendly Co-operation Between the United States and Latin America," and the fourth by Prof. Franklin H. Giddings on "The Western Hemisphere and the World of Tomorrow," to be delivered in Aeolian Hall, New York City.

The National Civic Federation meets in New York City December 3-5.

The General Contractors' Association holds its convention December 3 in New York.

The American Civic Alliance will hold a convention in New York City December 28.

The American Portland Cement Manufacturers' Association meeting for December is to be held in New York City.

The Illinois Water Supply Association, at a meeting held in Chicago November 11, voted almost unanimously to affiliate with the American Water Works Association as a section of that organization. H. M. Ely was selected as chairman of the section then organized, and Edward Bartow, Urbana, Ill., was selected by the executive committee as secretary. Papers were read by Langdon Pearse on "The Evanston Filtration Plant," and by Edward Bartow on "European Water Purification and Sewage Disposal Plants" as observed last summer.

The Minnesota Surveyors and Engineers' Society will meet at St. Paul in February, 1915.

The program for the road congress of the American Road Builders' Association, to be held at the International Amphitheater, Chicago, Ill., December 14-18, promises one of the most interesting and instructive sessions yet held. The exhibit of road materials and machinery is also most promising.

Technical Schools

The announcement of the graduate course in highway engineering at Columbia University for 1914-5 has been issued. The complete graduate course leading to degree of Master of Arts requires an attendance of two winter periods of four months each, or the equivalent thereof. As practically all the graduate courses are given in periods of from two to four weeks, it is, however, practicable for highway officials, engineers, chemists, contractors and others interested in highway engineering to take various groups of courses. During 1913-4 the following fields of activity were represented by the graduate students in highway engineering: State and county highway departments, 10; municipal highway departments, 17; university faculties, 3; contractors' organizations, 10; sales, engineering and research departments of companies manufacturing road and paving machinery or materials, 13.

The number of students in the undergraduate College of Engineering of the University of Illinois on November 1 was 1,202, ranging from 277 in the department of electrical engineering to 30 in that of railway engineering.

The Indiana University Bulletin for October, 1914, contains No. 22 of Indiana University Studies, on "The Flood of 1913 in the Lower White River Region of Indi-

ana," by Hal P. Bybee, A. M., and Clyde A. Malott, A. B.

The University of Illinois Bulletin for May 18, 1914, just received, is Water Survey Series No. 11, which contains the report for 1913 of the Chemical and Biological Survey of the Waters of Illinois.

Civil Service Examinations

Examinations will be held at the usual places by the United States Civil Service Commission as follows:

December 15: Hydro-electrical engineer in Quartermaster Corps, U. S. Army, at Camp John Hay, Philippine Islands, at $2,400 a year, transportation and expenses to the camp.

Personal Notes

Dr. J. A. L. Waddell and Mr. John Lyle Harrington announce the dissolution of the firm of Waddell & Harrington. The firm's business will he conducted as usual till the conclusion of its affairs in July, 1915, except that it is accepting no new commissions. Dr. Waddell will give his attention to special engineering and financial matters and to important advisory work. Mr. Harrington will be joined by the firm's associate engineers, Mr. E. E. Howard and Mr. Louis R. Ash, in the establishment of the firm of Harrington, Howard & Ash, consulting engineers, who will conduct a general consulting practice, similar to their past work, including hydro-electric development, advisory municipal engineering, appraisals, examinations and reports upon engineering projects, giving special attention to foundations, bridges, particularly movable spans, and other structures in steel and reinforced concrete, with offices at 1012 Baltimore avenue, Kansas City, Mo.

Mr. Harrington spent many years in bridge and structural shops, two of which he designed and operated, in the service of railroad companies, and in mechanical and electrical work. For three years he was the executive engineer of the C. W. Hunt Company of New York, and for two years he was chief engineer and manager of the Locomotive and Machine Company, of Montreal, the American Locomotive Company's Canadian subsidiary. For the past eight years he has been a member of the recently dissolved firm of Waddell & Harrington, consulting engineers, Kansas City, Mo., and in that capacity has developed the vertical lift bridge and directed the design and construction of many million dollars' worth of important bridge work.

Mr. Howard has been associated with Dr. J. A. L. Waddell for fourteen years, for many years principal assistant engineer and later associate engineer of the firm of Waddell & Harrington. His experience covers every phase of the firm's work, at various times directing the office work, having general supervision of field operations, and serving generally in executive capacity.

Mr. Ash has had many years' experience in engineering work, and from July, 1910, to April, 1913, was city engineer of Kansas City, Mo., in which capacity he was responsible for the design and construction of large undertakings, covering several million dollars' worth of sewers, paving, grading, flood protection work, etc. He also made an appraisal of the property of the Metropolitan Street Railway Company and was engineering adviser for the city in the street railway franchise negotiations. Mr. Ash resigned the office of city engineer to become associate engineer and office manager of Waddell & Harrington.

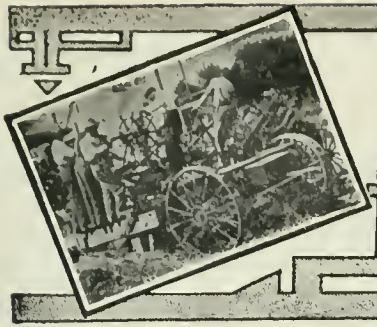
Secretary Lane of the Department of the Interior has appointed Garrett B. James, of the engineering staff of Underwriters' Laboratories, as consulting engineer in the Bureau of Mines, to carry forward an investigation of the subject of oil fires. Mr. James has been granted a three months' leave of absence by the laboratories and is at present in the Texas oil fields.

Publications Received

Municipal Charters, a discussion of the essentials of a city charter with forms or models for adoption. By Nathan Matthews, LL. D., mayor of Boston, 1891-5; chairman Boston Finance Commission, 1907-9; lecturer on Municipal Government in Harvard University. Cloth, 210 pp., $2 net. Harvard University Press, Cambridge, Mass.

Report on pollution of Des Plaines river and remedies therefor, made to the Board of Trustees of the Sanitary District of Chicago by George M. Wisner, chief engineer, and Langdon Pearse, division engineer.

Bell's School and Mine is one of a collection of essays on education, by William Suddards Franklin, published by Franklin, MacNutt & Charles, South Bethlehem, Pa., at 50 cents, in cloth.



MACHINERY AND SUPPLIES

The Development of the Road Paving Plant

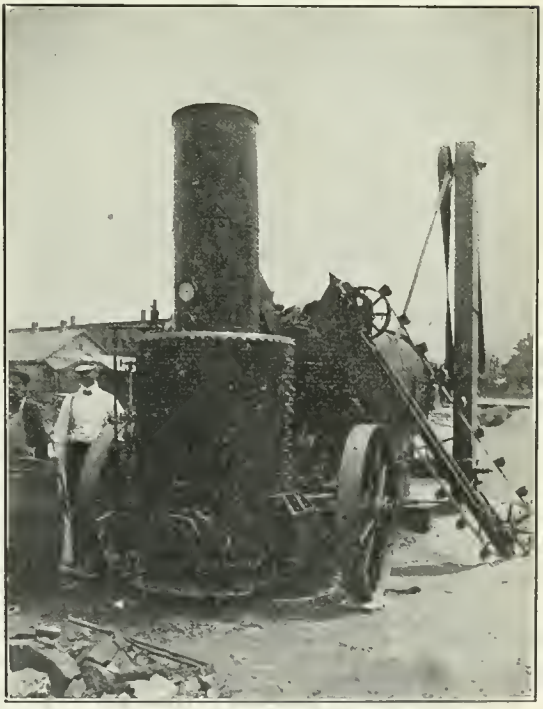
In the road making and paving industries there has been for several years an increasing need for a portable paving plant that could be operated successfully and profitably at points too far removed from a railroad to permit of the use of a portable railway plant; a plant which would also be sufficient, in matters of capacity and efficiency, to permit of the introduction of the asphalt or bituminous roadway or street into the smaller cities and towns which could not hold out to the regular paving contractor sufficient prospects of profitable business to justify him in going after such work with his large and expensive portable railway plant.

At first sight, to the layman, it would seem a simple proposition to produce such a plant, but many knotty problems present themselves to the inventor and mechanical engineer when this matter is studied. In the first place it is imperative that such an outfit be built within certain limits of bulk and weight, in order that it may be readily transported upon the ordinary platform freight car. It must not be too heavy to be hauled from place to place by a traction engine, or even horses if need be. It must also be designed and constructed so that it will withstand the racking caused by rough and uneven roads over which it may have to travel.

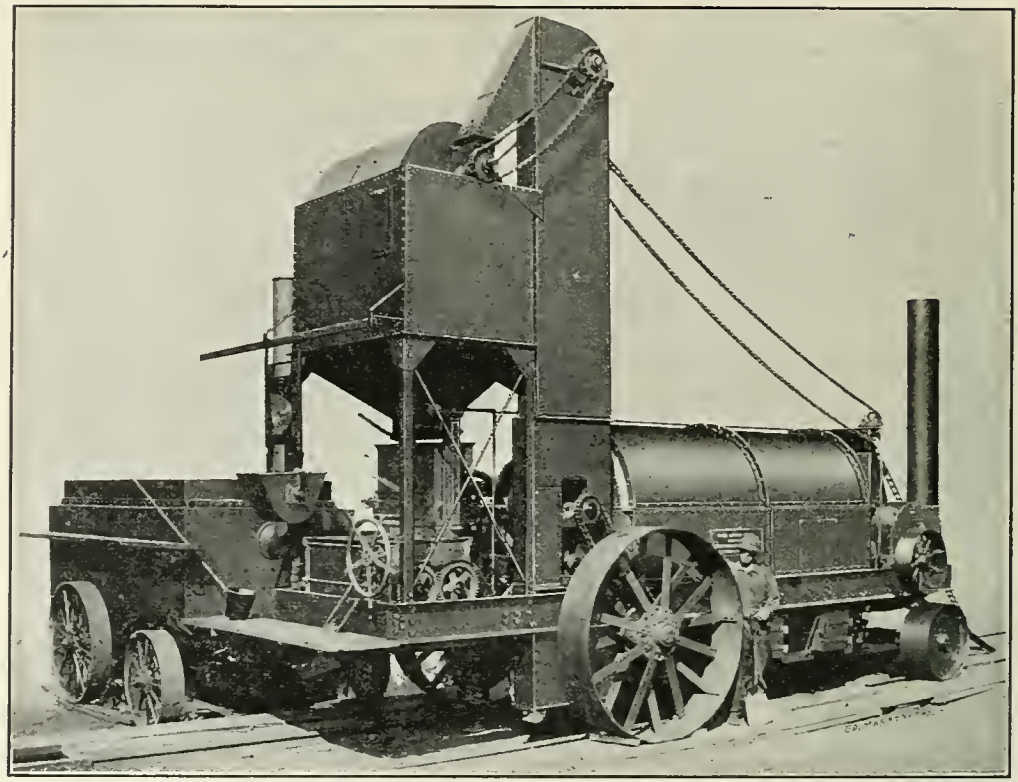
In the second place it is absolutely necessary that such a plant, in order to be worth while, must be capable of manufacturing not less than 500 square yards of finished pavement or road per day. No amount less than this can be handled with profit to the contractor.

In the asphalt paving business one square yard of sheet asphalt topping, 2 inches thick when compressed upon the street, has come to be generally accepted as the standard unit of measurement of plant capacities. The manufacture of sheet asphalt topping mixtures is the true test of capacity for a paving plant; mixtures for bituminous macadam and other like pavements are easier to make and can be turned out in greater quantities; consequently any plant which will turn out a given quantity of sheet asphalt mixture in a given time may be counted on for considerably greater output when other kinds of bituminous mixtures are being made.

During the past few years the efforts of manufacturers and inventors to produce a plant of this sort have resulted in the introduction of a machine com-



EARLY PORTABLE *Asphalt Paving Plant as made in* 1904.



PORTABLE ASPHALT MIXING PLANT *on trucks for use upon a street under improvement. the latest development in this line by Hetherington and Berner.*

monly known as a "hot mixer," which is not a regular paving plant, but is an expedient, and some engineers, on account of their opinion of the uncertainty of quantity and uniformity of its product insert a clause in their specifications for public work prohibiting that kind of a mixing machine. The capacity of the hot mixer is limited and uncertain, and it may therefore be unprofitable to the contractor.

Several other kinds of portable plants have been brought out within the past few years, but few if any of them have attained to any marked success.

The first illustration accompanying this article exhibits the beginning of the evolution of a portable road plant built by Hetherington & Berner. This first plant was built in 1904, and in July of the following year was used in the execution of a regular sheet asphalt paving contract in the city of Saginaw, Mich., and turned out material for more than 20,000 square yards of 1½-inch topping, going thru the job at the rate of 800 yards per day. It is still in use and has worked in many different places since that time.

Since the production of that first plant of this class the makers have redesigned and improved upon it many times, until they feel assured that in their latest model they have achieved finality in that direction and have produced a plant which is a close rival of the smaller railroad plants in the matter of capacity, and a plant that is first-class in every way and which can be sold at a price which ought to put it into the hands of contractors who have not been able hitherto to own a railroad plant.

This new plant has a working capacity of from 750 to 1,000 square yards of 2-inch sheet asphalt topping per day, is well built and operates with the minimum of labor. The main element of the success of this plant is the sand and stone heating drum. This is 5 feet in diameter and of an especial and new construction in the matters of the internal stirring and conveying devices, which has greatly increased the efficiency of this type of sand drum. The sand drum is mounted upon a frame or chassis made of steel struc-

tural material, and the chassis is carried by four steel built-up wheels, designed and built especially for the plant by Hetherington & Berner in their own shops.

The castings used in the construction of this new candidate for favor are made of steel in all parts where steel might have any superiority over good cast iron. The plant has embodied in its design several of the patented features of the Hetherington one-car railway plant, such, for instance, as the folding hot-sand elevator, the turn-down sand bin, etc. The hot-material storage bin is made with divisions which render it quickly adaptable for making mixtures for bituminous macadam pavements. The mixing machine is of sufficient size for an output of 1,000 square yards per day. The sand heating and mixing part of this plant constitutes one unit, complete in itself; other units consisting of one or more melting kettles mounted upon wheels operate in connection with the heating and mixing unit.

In one of the modifications of this portable plant an engine and boiler was added to the elements of the heating and mixing unit and this unit was made self-propelling, but experience demonstrated that the addition of the automobile or self-propelling feature was not advisable, because of the greatly increased weight and complication of mechanism.

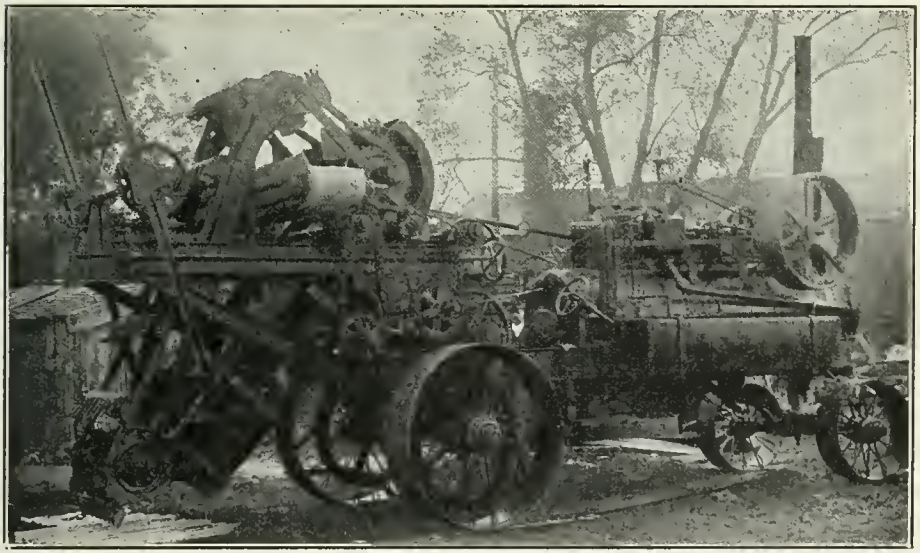
As this outfit is now offered to the trade, driving power must be obtained from another source, either a portable steam engine, a gasoline motor or an electric motor. Inasmuch as a traction engine must necessarily form part of the equipment of a road-building contractor, it may be readily used for the purpose of supplying motive power for one of these road-making plants.

Clark's Traction Grader

A traction grader which excavates and conveys the material on the principle of the rear-end trench excavating machine is shown in the accompanying photograph. Its general design is seen clearly.

On the front end of the machine is a 20-h.p. horizontal boiler of the locomotive type, with a horizontal 20-h.p. reversible link motion engine rigidly bolted to the shell of the boiler. The driving mechanism is a system of pulleys and friction clutches, most of which is visible in the picture. It is so designed as to relieve the machine of shock and strain when large stones or other obstacles are run into.

At the rear is the bucket excavator and conveyor. The digging buckets are 3 feet long and 6 inches deep, and are equipped with detachable knives. Buckets are placed on the chain at proper distances to insure the most efficient work. The wearing edge of the buckets is drawn out to a knife-like edge. The chain operating the buckets, and to which they are attached, is designed to withstand the unusual strain to which it is subjected. It carries the buckets over two drums at the top, 3½ feet apart, and discharges their



CLARK'S TRACTION GRADER, *available for street grading, water and sewer trenching, old macadam separation, etc.*

contents on a conveyor which can be reversed so that it can deliver the excavated material to wagon on either side of the machine.

The buckets cut to the grade set at all times. The width of cut is 36 inches and the depth from 3 to 18 inches, and from 60 to 100 cubic yards can be excavated per hour.

The grader is self-propelling at 2 to 3 miles an hour. A complete compensating mechanism is employed, which allows it to turn round in a very small circle without undue strain on any part. When in operation, the machine will travel at the rate of 5 to 25 linear feet a minute, as the work requires.

The grader is 24 feet long, 8 feet wide and 11 feet high. Centers of front and rear wheels are 14 feet apart. Rear wheels are 54 inches diameter and 14 inches face. Pilot wheels are 36 inches and 12 inches. The total weight of the machine is 13,000 pounds.

It is claimed that the machine will do the work of 50 men at a saving of at least $80 a day.

The machine can be transformed into a trenching machine to excavate 2 to 3 feet wide and 3 inches to 12 feet depth by substituting the necessary extra parts in the excavator and elevator end.

Joseph H. Clark, the inventor of the new machine, has been engaged in the work for many years and has designed other successful machines of the same general nature, on which the latest machine is claimed to be an improvement. The Utility Road and Farm Machinery Co., Chicago, Ill., manufacture the grader and will give full information concerning it.

Street Signs and Sign Posts

A very strong, durable and economical street sign post now on the market has a main standard of 2½ by 2½ by 3/16 inch angle iron, of the proper length to hold the signs 7 or 8 feet above the ground. Signs are attached in a very simple manner to a square iron casting, back to back in pairs, at right angles to each other, or in other words, a four-way sign, fastened together with brass bolts.

The posts are made for placing either in the ground in the parkway or on the cement sidewalks in the business districts. The parkway post is to be placed in the ground 30 inches. The bottom of the angle-iron post is first flattened and then turned at a right angle, so that the bottom end has a wide horizontal flange. To this is securely riveted a 3/16-inch plate 10 by 10 inches to set in the bottom of the post hole, above which concrete can be placed if deemed necessary to more

STREET SIGN POST *of angle iron as designed for use in parkways or lawns along the streets.*

securely hold the post in position. At the ground surface and extending 10 inches downward is another angle iron plate 10 by 4 x 4 by 3/16 inches, securely riveted to the main angle iron standard. This affords lateral resistance from four directions, and at the same time serves the purpose of giving double strength and double thickness at the point where there is the greatest strain on the post, and where the rusting and corroding takes place in all posts, just at the point where the air, water and earth come together.

The post to be used in the business district has a heavy cast iron base extending 22 inches above the sidewalk, and this cast iron base is reinforced in the back by the angle-iron standard itself, which runs clear to the bottom of the post and is securely riveted to the iron casting, giving to the post very great strength at this point.

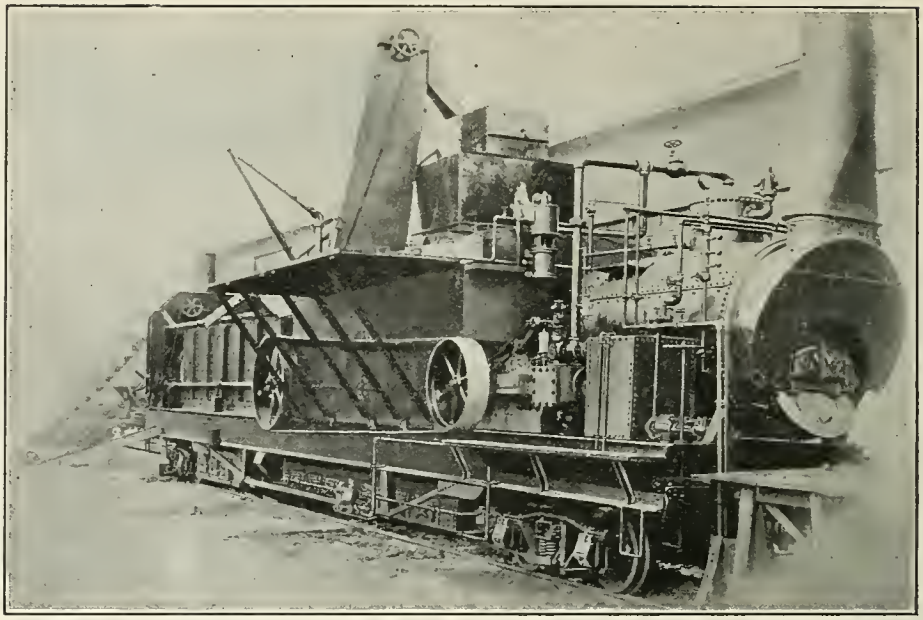
This angle iron post is made from old railroad rails re-rolled and will not break off when given a heavy blow, but will spring back to place. It does not have certain difficulties inherent in the gas pipe or hollow post. Thus a hollow post is constantly sweating on the inside, because of the difference between the temperature inside the post and outside. The wind and air cannot get at the inside of the post to dry it, neither can one get at the inside of the post to paint it; therefore the rusting process is constantly going on inside, while the outside may be kept painted and looking well. Then, too, the gas pipe is easily bent. The accompanying cuts show two designs for posts for use in parkways.

The enameled steel sign has demonstrated its value for use in naming streets. The signs are made by firing and fusing vitreous enamels into 18-gage steel or iron, under 2,000 degrees Fahrenheit; therefore they are guaranteed not to fade in any kind of weather. There is a glass surface finish, giving a luster that is attractive. They are more readable at night than any other sign not illuminated. European cities have used them for forty years and American cities for ten or fifteen years.

For street sign posts to go in the parkway, 30 inches in the ground and 7 or 8 feet above ground, making the post about 10 feet over all, without the signs, prices vary from $3.50 each in lots of 25 to $2.25 in lots of 200. For the same kind of post, except that it is made to set on the cement walk and fasten to the walk, with a heavy cast iron base and shorter than the parkway post, without the signs, the cost is from $4.50 in lots of 50 to $3.70 in lots of 200.

Another style of angle-iron post, lighter and for the parkway, and a 2-way sign only, is of 2 by 2 by 3/16 inch angles, and

STREET SIGN POST *of angle iron for permanent or temporary danger signs and other notices along roads and streets.*



ASPHALT PAVING PLANT *equipped for melting asphalt; on one railroad car, as designed by F. D. Cummer & Son.*

costs $1.90 in lots of 100 or $1.70 in lots of 200. This post has a different base and is now in use at Gary, Ind.

Brackets for attaching signs to trolley poles, electric light poles, etc., either wooden or iron poles, cost from $2 in lots of 25 to $1.50 in lots of 200, not including signs.

Steam Melting Asphalt Plant

Carelessness in handling plants melting asphalt by direct heat has been responsible for some failures in asphalt paving by burning the asphalt. There has been some discussion of this matter in recent communications to MUNICIPAL ENGINEERING, to which reference can be made for information. There are asphalt plants on the market which melt the asphalt by heat derived from steam pipes, in which it is practically impossible to burn the asphalt. One of the latest designs in this class is the Cummer one-car steam melting asphalt plant, which is shown in the accompanying photograph.

This plant is identical, except as to the melting end, with the Cummer direct-heat one-car asphalt plant of which about seventy-five are in use, some of them for the past ten years. The plant has a 125-h.p. Scotch horizontal internally-fired boiler. The two open asphalt kettles have a combined capacity of 1,450 cubic feet. They are 9 feet 6 inches long by 8 feet wide, with flat bottoms and almost continuous clean-out doors on both sides at the bottom. They are easily and thoroly agitated with air or steam. Each kettle has four sets of 1½-inch extra heavy continuous coils, so that the full capacity of the boiler can be used if desired, and a trap which keeps the coils free from condensed water and returns the condensation to the boiler. A kettle of asphalt is melted in four to six hours, depending on the kind of asphalt.

The 25-ton sand and stone dryer, 10-cubic-foot steam-jacketed mixer, 20-ton hot sand and stone storage bin, two cold material elevators, encased hot material elevator, engine, trucks, car frame, piping and other appurtenances are the same as on the well-known Cummer standard one-car plant.

To the Cummer patent sand drum is attributed the large capacity of the plant, 2,000 square yards of 2-inch top per ten-hour day or the equivalent in binder or asphaltic concrete of Topeka specification, and a 10-foot special mixer is used now instead of a 9-foot mixer, so as to take care of the drum output.

The F. D. Cummer & Son Co., Cleveland, O., will send full information about the new plant.

Fibre Conduit

The process of manufacture of Orangeburg fibre conduit is fully set forth in the third edition of the catalog of The Fibre

Conduit Co., Orangeburg, N. Y., which has recently been issued. The standard specifications contained in the catalog give the requirements that should be made of the conduit and of each of the types of joint used in putting the sections of conduit together. The various connections and specials are fully illustrated and dimensioned and tables of the characteristic dimensions of fittings for all sizes of pipe are given.

A good share of the catalog is taken up with statements of the advantages offered by the fibre conduit in the socket joint type, the sleeve, screw and Harrington joint types, small weight, handling, laying, rodding, water and acid resistance, prevention of electrolysis, mechanical strength, etc. There are also illustrations and brief descriptions of a number of installations of fibre conduit for various purposes, and of methods of construction of conduits, manholes, etc., and tables of costs of the same.

Acoustic Difficulties in Auditoriums Corrected

Since its erection in 1910, the Amasa Stone Memorial Chapel of Adelbert College has proved to be unsatisfactory acoustically. The general shape of the building, which is one of the Western Reserve University group in Cleveland, Ohio, is a long and narrow rectangle 140 feet by 30 feet, and experiments showed the difficulty to be due to general reverberation.

It was suggested that a sounding board be installed to eliminate this reverberation, and Prof. Frank P. Whitman, of the university, undertook a series of experiments to determine as accurately as possible just what benefit would be secured by this means.

Great care was taken to make the tests under conditions as nearly as possible like those of the ordinary use of the chapel, and involved the actual hearing of ordinary speech. The final comparative test was made first without and then with the use of the sounding board.

This board was of the horizontal type, generally considered most effective, hexagonal in shape, and 6 feet in diameter, surrounded by a vertical rim which extended 6 inches below the plane of the board. It was supported at a height of a little more than 2 feet above the head of the speaker.

Final results showed that the greatest benefit obtained by the use of the sounding board was to make the hearing 2 per cent. better in some parts of the building under certain conditions, while it actually made hearing less easy in the gallery.

Prof. Whitman showed that, for all practical purposes, the sounding board was useless.

The H. W. Johns-Manville Co. was then asked to undertake the correction of the chapel by its system based on the scientific researches of Prof. Wallace C. Sabine, of Harvard University. J-M acoustical treatment was applied to the ceiling panels and upper walls, and resulted in the elimination of all the acoustical defects.

CHAPEL OF ADELBERT COLLEGE, *acoustic defects of which have been corrected by treatment of ceiling panels and upper walls.*

AUTOMOBILE TRUCKS *for commissary Departments of European armies. The third shipment of like size since October* 1 *made by the Kissel Motor Car Company.*

The accompanying photograph shows the interior of this chapel which must stand as a monument to the remarkable success to be obtained by this method of treatment.

KisselKar Tractor on Hook and Ladder Truck

At a recent firemans' tournament, held at Riverhead, L. I., a new hook and ladder tractor recently placed in service by the municipality of Patchogue, L. I., attracted great attention and comment. The front wheels of the old horse-drawn truck had been taken off and the tender attached to a sturdy 1½-ton KisselKar chassis. It was pronounced a very handsome job and is said to be giving remarkably efficient service. It is the only motor-driven fire department tractor on Long Island.

Trade Notes

Among the contracts awarded to the Raymond Concrete Pile Co. are concrete piles in the foundations of the North Hill School, Burlington, Ia.; foundation of Wayne street viaduct, Butler, Pa.; foundation of a building to be erected as a memorial to women of the Civil War, Washington, D. C.

The MacArthur Concrete Pile & Foundation Company has sold the patent rights to drive the pedestal pile in Japan to the Oriental Compressol Company of Tokio, Japan, and has appointed Douglas-Milligan Company as their sales agents for Eastern Canada, with main office in the New Birks building, Montreal, and branch office at 95 King street East, Toronto.

The Alliance City Clay Product Company of Alliance, Ohio, is the latest acquisition to the family of licensees of the Dunn Wire-Cut-Lug Brick Co., of Conneaut, Ohio. Others who have joined recently are Springfield Paving Brick Co., Springfield, Ill.; Terre Haute Vitrified Brick Co., Terre Haute, Ind., and Albion Vitrified Brick Co., Albion, Ill.

Floyd F. Woods has been appointed sales manager for the Epping-Carpenter Pump Co. of Pittsburg, Pa. Mr. Woods takes the place of R. Bowen, who is no longer connected with the company.

Trade Publications

The world's greatest asphalt plant, that of the Barber Asphalt Paving Company at Maurer, N. J., is described in a well-illustrated booklet issued by the company, which can be obtained on application to the Philadelphia office.

The Thomas B. Jeffrey Company, Kenosha, Wis., issues a fully-illustrated reminder of the Jeffrey dealers' convention, devoted especially to the Jeffrey Quad truck and the new automobile models.

The Western dump wagon is the subject of a circular of the Western Wheeled Scraper Company, Aurora, Ill.

The subject of a recent booklet of the De la Vergne Machine Company, 1165 E. 138th street, New York City, is "The Easiest Profits," showing the low cost of the De la Vergne oil engine power plant in comparison with motor-driven and steam power plants, the ratio of expense of a 100-h.p. engine running ten hours being as $1.88 for oil, to $7.00 for steam and $15.00 for electric current.

Aztec road surfacing asphalt for worn-out and ravelled macadam roads is the subject of a recent booklet of The United States Asphalt Refining Co., 90 West St., New York City.

The Bulletin of the Universal Portland Cement Company for October has a list of illustrated articles on uses of cement well distributed over the whole field of roads, bridges, warehouses, water towers, etc.

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MUNICIPAL ENGINEERING

The World's Leading Municipal Publication.

A Police Squad Equipped with Motorcycles.

VOL. XLVIII. JANUARY, 1915. NO. 1.

The circumstances under which the great majority of appointments to positions in the municipal service have been made in this country have given rise to a theory very generally held that almost anybody could "fill a city job." A large percentage of our people are firmly convinced, for some reason which is not easily explained, that municipal service is different from private service and that a certain amount of common sense and a willingness to work are all the requisites that are needed to fill such a position efficiently. We have worked during this administration and in this department under an assumption that these by no means constitute all the requirements. We believe that municipal service has everything to gain and nothing to lose by accentuating the points in which it is like the service in private institutions, and by minimizing the importance of those things in which it differs from private undertakings.—Morris Llewellyn Cooke, Director of Public Works, Philadelphia, Pa.

Published by

Engineering Publishing Co.
INDIANAPOLIS, IND.

New York Office:
1127 World Bldg.
Geo. H. Clingan,
Eastern Mgr.

Chicago Office:
1634 Marquette Bldg.
E. D. Powell,
Western Mgr.

Entered at Postoffice, Indianapolis, as Second-Class Matter.

A. P. Fox, President. C. C. Brown, Editor. C. S. Sale, Gen'l Mgr.

Subscription Price in U. S. and Possessions, Cuba and Mexico, $2.00. Canada, $2.40. Foreign, $2.75.

Changes of address, subscriptions, remittances and editorial matter should be addressed to Municipal Engineering, Indianapolis, Ind.

THE CLEANING OF WATER MAINS

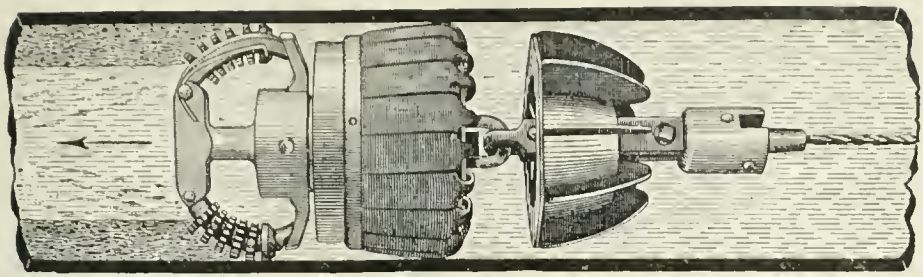
By J. F. Springer, New York City.

Cleaning of water mains is a difficult operation which was long considered too expensive for application. The reduction in capacity of mains at the same time with an increase in demand, has brought water works plants to the point of laying additional mains on the one hand or of cleaning the existing mains on the other. Methods of cleaning have developed slowly and have been reported from time to time for several years in MUNICIPAL ENGINEERING. *They have reduced the expense with the increase in efficiency. This article shows the principal methods now in use and the difficulties and expense to be met in cleaning systems of pipes not originally designed and constructed with facilities for subsequent cleaning.*

THERE are two distinct methods of cleaning the interior of a water main. One of these proceeds by dragging the cleaning device thru the pipe by means of a steel cable. The other operates by means of a cleaning machine which is carried thru the main by the force of the water. The cable system is used with very small pipe, from 3 to 6 inches diameter. For moderate sizes of pipe, from 6 to 10 inches, either system is applicable, while for still larger sizes the water-driven device is employed. These are general statements; particular conditions may impose some variation. In fact, in cases where the pipe is large and conditions in general indicate the water-propelled device, it will still be necessary to employ the cable system in the immediate vicinity of the reservoir where the pressure is either nothing at all or too low to furnish sufficient driving force.

The pipe system is laid off in sections which may vary from 50 feet in length to half a mile. Particular attention will be directed to making the sectional divisions at abrupt turns, the object being to avoid including them in the inaccessible parts of the pipe. An excavation will be made at each end of a section and portions of the main exposed. The length of pipe exposed at either excavation will vary from 2 to 6 feet or more, according to circumstances. The cleaning will be done in the direction of the flow of the water. The water will be turned off, but not until a length of pipe at each excavation has been diamond-pointed to a point within perhaps ⅛ inch of the thickness of the cast iron. These lengths will be entirely cut out after the shutting off of the water. Ditch pumps at the two excavations will take care of the dead water coming from the pipe. At the far end, looking in the direction of flow, a bend and straight length will be yarned in, the object being to provide a discharge end for the section of main that is now to be cleaned. The riser pipe will project obliquely above the surface. Up to this point, the general method of procedure is the same whether the cable system of cleaning is employed or that which uses the water-propelled machine.

Assuming that we are proposing to use the cable, we must now go ahead and get it thru the section of pipe. A winch with perhaps half a mile of steel rope is set up at each end of the section. At the near end the rope will be small, say 3/16 inch in diameter; at the far end, larger, say ⅜ inch in diameter. At the near excavation, either a special hatch box will be put in



TURBINE *machine for cleaning water mains. The water pressure from the left forces the machine thru the pipe. The revolving cutters in front scrape off the encrustations on the pipe, and water, let thru adjustable openings in the piston, revolves the cutters and forces the debris forward. The cord at the left serves to locate the machine if it is stopped for any reason.*

place of the short length of pipe removed, or else a piece of ordinary pipe together with a sleeve will be arranged. A special device is put into the hatch box or arrangement of pipe. This is known as the carrier. Its function is to transport the end of the small rope thru the section of main. The rope is passed thru a stuffing box or perhaps thru a simple hole into the pipe and there secured to the carrier. When these arrangements have been made and the connections are found to be sufficiently tight, the water is turned on. The carrier is so designed that the flow carries it along thru the main and out at the far end. The carrier is now detached and the two ropes are secured together. The winch at the near end is operated and the small rope pulls the big one thru from the far end to the near end.

When the ⅛-inch cable is in place, the cleaning device is put into the hatch box, or the temporary pipe, with the cable attached. The hatch box or pipe is made up and the water turned on, but not at full pressure. The winch at the far end is started and the cleaning begins. Sometimes the carrier will stick. Its location may be determined by noting the amount of small rope withdrawn. An excavation will be made at this point and the difficulty dealt with.

The design of the carrier is quite interesting. In the patented device used there is first of all a cup or bell-shaped piece which fits into the main snugly, with its concave side opposed to the flow of the water. On the convex side the bell, made of rubber or other flexible material, is attached to a short cylindrical piece, which may be of wood. Stays of metal are attached to this piece and extend back to the bell, to which they are secured and supply it with resistance against a folding-forward movement. It will be understood that these stays are aranged at intervals in the circuit. Thru the piece of wood a wire passes, the rear end of which has an eye for the attachment of the steel rope. At the forward end of the device a cage in the form of a double pyramid is arranged. This contains within it a spherical shell of metal. This shell acts as a float, supporting itself and the cage. This part of the device acts as a guide. Because of its tendency to keep to the top of the pipe, it facilitates passage over lumps of lead lying on the bottom and past downgoing branches of the pipe. This apparatus has been in practical service, where it has demonstrated its capabilities.

If the pressure of the water is considerable, the use of the cable may be dispensed with and the water relied on to energize the cleaning device. Suitable pressures and other favorable conditions are usually found in connection with the larger sizes of water mains, say from 6 inches diameter up. In one device, propulsion is secured by means of a pair of pistons arranged with cleaniug devices ahead and to the rear. The pistons have adjustable passageways thru them. These permit the passage of a restricted amount of water on ahead. This is a very necessary part of the ar-

rangement, as otherwise the heavier cleaning would have to be done in the dry. The forward cleaners consist of a series of spiders carrying suitable knives or scrapers. These knives are set at right angles to the direction of the movement. To the rear of the pistons, two or three spiders are arranged with knives set at an angle to the axis of the pipe. By means of a kind of jointed or flexible shaft, the entire apparatus of cleaners and pistons is secured together, the whole having the appearance of a gigantic insect.

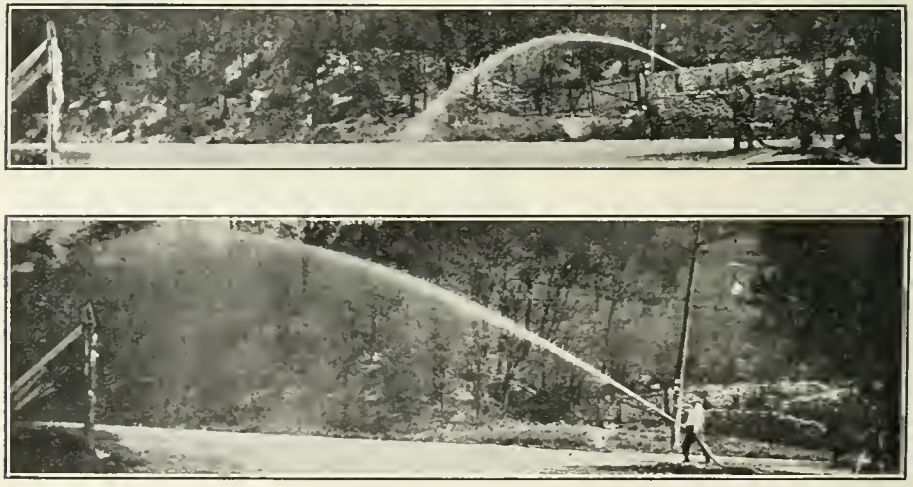
The cleaning is done by putting this affair, right end foremost, in the hatch box or the pipe arrangement at the near excavation and closing it up. When the water is turned on, the impulse against the pistons carries the device along. The knives cut and scrape, and are kept at their work by means of suitable springs or the like. The moderate amount of water passing thru the machine operates to carry off the debris from the walls of the main. In fact, an arrangement of blades diverts some or all of this water from the center outwards and thus puts it where it is mostly needed.

The adjustment of the orifices thru the pistons calls for practical experience. Once the machine starts, it cannot be recalled for better adjustment. Enough water must go thru to facilitate the cutting and to carry off the debris; enough must be left behind to drive the machine forward.

While the machine can not be recalled, still it may usually be located. There are three methods of doing this. First, the machine makes some noise. This is often sufficient to enable the ear to follow its forward movement. Second, the fire department hydrants will furnish by the character of the flow from them a means of approximating the position of the cleaning machine. Third, a small rope may be attached to the rear of the machine before starting it off. The length of this drawn in will serve to give the distance of the machine from the near excavation.

Another type of water-driven cleaner is sometimes used. This machine is a very effective piece of apparatus, being able to handle work that the other machine either can not do or can not do to advantage. This cleaner consists in part of a water driven turbine. The pressure of the water acting on a piston effects the drive. A certain amount of water, however, is permitted to pass thru the turbine, setting up a rotary movement of part of the apparatus. This circular motion is utilized to effect a scrap-

TWO PHOTOGRAPHS, *one taken before cleaning and one after, show the improvement in discharge from a hydrant on the water distribution system at Madison, Ind., by cleaning the mains.*



ing and cutting action across the direction of movement of the whole device. This rotary effect has proven very successful. Thus, at Salt Lake City, there was certain piping 16 inches in internal diameter which had an incrustation 2 inches thick. So difficult was the cleaning operation that the ordinary machine method proved scarcely adequate. In order to get results, the ordinary apparatus had to be taken thru repeatedly. The turbine machine was found quite competent for the work.

¶ PROVISION *for subsequent cleaning should be made during construction or in connection with the first cleaning of an existing system.*

The cleaning of water mains by the foregoing methods has proved a very practical business. It is not a theory of what might be accomplished; but something which has been demonstrated by 500 or 600 miles of actual cleaning done under some form of contract. In the Boro of Brooklyn, New York City, alone, the amount of cleaning up to date totals in the neighborhood of 75 or 80 miles. In some communities the procedure has been carried out more than once.

In fact, the special hatch box used for the opening up of the main itself is a device which is used in contemplation of repetition work. The hatch box is put in as a permanent part of the line. This installation has been made in some cases a part of the cleaning operation. But in some others, the hatch boxes are introduced into the line at the time of original construction. This is notably the case at Troy, N. Y., where the 30-inch line is being equipped at intervals with this device. This special fitting consists essentially of a short length of pipe with the regulation nozzle and bell ends. There is, however, a portion of the body cut away. Here is provided a cover with bell ends. The cover is bolted in place and so may be accurately and quickly put in position. When the cover is in place, the whole forms simply a section in the pipe line. The internal diameter is, however, greater thruout most of its length than that of the pipe line. At the forward end the connecting taper is gradual. This taper is thus suited to the progressive compression of the cleaning device as it starts on its journey, and so facilitates the start off. At the rear end, there is, of course, a connecting taper, but it is fairly abrupt. The device is a patented one.

¶ COST OF CLEANING *in specific instances is given, with statement of conditions, that some idea may be gained of the probable cost in ordinary cases.*

The cost of cleaning varies with the local conditions. The principal concern engaged in the work supplies the foreman labor and the equipment. Perhaps as good an idea of the expense as can easily be acquired will be obtained by considering the case of Hartford, Conn., where a considerable amount of cleaning was recently carried out. This city is supplied by three mains, all cast iron. The diameters are 20 and 30 inches. All begin at a single reservoir several miles from the city hall. The ages at the time of cleaning varied from 16 to 37 years. The consumption of the city was steadily advancing, and it was realized that a new main would soon become inevitable. However, it was also seen that if a thoro cleaning of 9 miles of main would result in restoring the efficiency of the mains to a point which would make it possible to defer the installation of a new 36-inch pipe line for five years, not only money for the cleaning would be secured from the delay, but also money in excess. The minimum cost of the new line, 6¼ miles long, has been put at $270,000. In five years, interest compounded at 5 per cent. would amount to $74,500. An advance estimate of the cost of cleaning 3 miles of 30-inch pipe and 6 miles of 20-inch pipe put the cost at $15,300. Consequently, it was clearly to the advantage of the city to do the cleaning. But Hartford desired to be sure, before going ahead. So inquiries were made, amongst others, of Cincinnati, Rochester, Newton, Mass., St. Louis,

TWO PHOTOGRAPHS *show the increase in force of the flow from an open hydrant on a 4-inch main in Newport, Ky., made by cleaning the main.*

Brooklyn, Atlanta and the American Water Works & Guarantee Co. of Pittsburgh. All had had experience with large pipe. Apparently the replies were, on the whole, satisfactory, as a contract was entered into for a trial cleaning of 3 miles of 20-inch pipe. Ultimately, 6¼ miles of pipe were cleaned. The actual contract price for the first 3 miles, as stated by the Chief Engineer of the Board of Water Commissioners, was 28 cents per linear foot, the contractor furnishing all labor concerned in the cleaning operations. There was to be a reduction if a greater length was cleaned. Ordinarily, at Hartford, there was a force composed as follows: 1 superintendent, 1 foreman, 1 calker, 14 ordinary laborers and a 2-horse team. The minimum pressure available was something in excess of 10 or 12 pounds per square inch. These pressures are ordinarily sufficient to drive the spider type of machine, the one employed for the work. There were three spiders in the forward section. These had cutters with saw teeth. Then came two spiders with smooth scrapers. Following these were two pistons. Behind them, bringing up the rear, were two rings of scrapers set askew. These scrapers were, in the one case, set in agreement with a right hand thread; and, in the other, with a left hand thread. In the whole machine, there were thus 7 separate circlets of scraping tools. The main cutting is done ahead of the pistons.

The cleaning at Hartford was suspended after cleaning 6¼ miles because of the scarcity of water in the reservoirs. Five miles belonged to the 37-year-old 20-inch pipe and 1¼ miles to the other 20-inch main, which was 25 years old or more. Careful tests of capacity were made in both cases both before and after cleaning. After cleaning, the capacity in both cases was found to approximate that for new pipe. Further, the increase in capacity in the older line was found to be 69 per cent. In the case of the younger main, the increase was 50 per cent.

The consumption of water in the cleaning process was experimentally ascertained to be about 3 times the quiescent capacity of the portion of pipe cleaned. Altogether, it is estimated that the 6¼

miles of 20-inch main required 1,655,000 gallons.

The material which clogs a pipe may be iron oxide or it may be a calcareous deposit, or something still different. The thick deposit mentioned as occurring at Salt Lake City seems to have been a carbonate of lime. In color, the material may be almost white; then it will be a red or a gray or a still darker hue. It is composed at times almost entirely of ingredients furnished by the water alone. At other times, the pipe itself will contribute a considerable percentage. Sometimes the obstruction in a pipe will consist largely of sediment made up of mud, rock particles and dead organisms. Such obstruction is usually fairly soft and presents but little difficulty in cleaning.

It will readily be granted that where the effective cross-section is cut down, so also will the capacity of the pipe. However, the flow of water is nearly always impeded to a considerable extent by small incrustations which scarcely affect the cross-section. Incrustations in the form of small and separated nodules will seriously affect the velocity. They may be not over 1-16 or ⅛ of an inch in height. Such nodular incrustations were sufficient in the case of a 48-inch main to reduce its capacity 30 per cent. This loss must be attributed almost entirely to friction; the nodules must have reduced the cross-section only by an inappreciable degree. That such excessive reduction of capacity may result from simple roughness of surface is confirmed by experience with coated pipes. It is said that a variation of as much as 25 per cent. may arise from the greater or less degree of smoothness of the coat put on. It is clear then that we have in the mere roughing of the surface a serious cause of reduced efficiency.

It will be understood then that a cleaning operation may be indicated as the proper step even where the cross-section remains approximately the same. The way to get convincing testimony is to compare a test of efficiency when pipes were new with another test made at a time when substantial loss of efficiency is suspected. Or, comparison of present flow with the flow that should be attained is another method of testing the matter. This is not as satisfactory a procedure as the comparison of two actual performances, inasmuch as the calculation of what should be turns on formulae, in using which it is difficult to take into account the special local conditions. In comparing two actual performances, nearly all the important factors except the incrusted interior are precisely the same for both. This results in reliable information.

PUBLIC BATH AND GYMNASIUM

The most extensive public bath and gymnasium yet designed for New York is located opposite Chelsea park. William Emerson is architect of this handsome and convenient building, photograph of the drawing for the front of which is shown herewith. It provides public laundry in the basement, boilers and machinery for heating, lighting and ventilating the building and supplying water for shower baths and pool, swimming baths and gallery in first and second floors with shower and tub baths on the remainder of both floors; gymnasium in the third and fourth floors with running track around at the level of the fourth floor, and outdoor play space over the entrance lobbies and stairways, on the level of the fourth floor and over the rest of the building on the fifth floor. It cost about $165,000.

Street Lighting Fixtures

The modern high-candle-power incandescent electric lamps have made necessary entirely new designs for fixtures for street-lighting service. Some of these new forms are illustrated and described in this article, which will give data for comparison with other modern systems by those contemplating improvements in their present street lighting.

THE introduction of high candle-power Mazda lamps and the new conditions under which they operate required the design of an entire new line of fixtures to accommodate them properly. The several specific reasons that have induced the development of these distinctly different types of fixtures are the following:

1. The intense brilliancy of the lamp reqnires that the light source be screened in order to obviate all of the disadvantages from glare.

2. The lamp in operation is designed to reach a very high temperature, and it is essential that the fixture be so ventilated that it is maintained at a temperature which will do it no injury.

3. The lamp must be protected from moisture and atmospheric changes.

4. The shape and size of the bulb being different from that of previous standards of the vacuum lamp, it was necessary to make a fixture that would bring the light center to the correct location.

5. Due to the fact that high-current series lamps operate at a very much greater efficiency, it is very desirable to provide an individual compensator in each lamp that will increase the current in the lamp from 6.6 or 7.5 amp. to 15 or 20 amp., as the 400 c-p. lamps operate at 15 amp. and the 600 and 1,000 c-p. lamps at 20 amp.

To provide for these contingencies, complete lines of street lighting fixtures have been designed that fulfill every requirement. In general, these fixtures may be divided into three different classes, namely, bracket type, pendant type and ornamental type.

The bracket and center-span suspension fixtures, which are almost universally known, have been re-designed to accommodate the following reflecting equipment: Radial wave reflector, concentric reflector or concentric reflector with prismatic refractor.

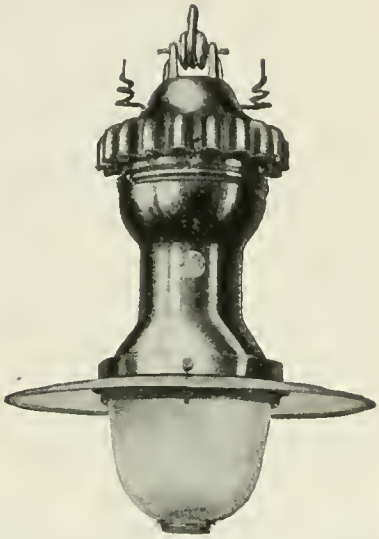
The pendant units have been designed in two different classes, known as Form 1 and Form 2. The Form 1 unit has been designed to resemble the arc lamp in general contour and appearance. It has a very substantial construction thruout. These units can he furnished with an opal diffusing globe, an opal diffusing globe and concentric reflector, a prismatic refractor and clear globe, or a prismatic refractor.

The Form 2 pendant units are unique in appearance and cost less than the Form 1. They are arranged to use a diffusing globe, concentric reflector and diffusing globe, radial wave reflector, or a concentric reflector and prismatic refractor. Both the Form 1 and Form 2 units are arranged to take a compensator, which is mounted nnder the dome and inside of the casing.

The ornamental Novalux Unit has been designed to fill the demand for a highly ornamental unit where "White Way" lighting is desired; and two different styles of ornamental units, known as the Forms 4 and 5, have been standardized.

NOVALUX *ornamental street lighting unit with upright lamp.*

PENDANT *Novalux street lamp resembling an arc lamp in appearance.*



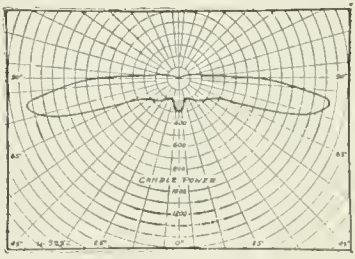
DISTINCTIVE *original design for Novalux street lamp, which is also cheaper.*

Light distribution from a bare incandescent lamp is not suitable for street illumination. By using the various forms of fixtures equipped with reflectors and outer globes, this distribution, altho at a decrease in specific consumption, is improved to such an extent that the illumination is more economical. It was not, however, until the introduction of the prismatic refractor that the distribution from incandescent units could be so directed as to produce a decided maximum at an angle approximately 10 degrees below the horizontal. With such a distribution, it is now possible to increase the spacing of these lighting units without destroying the even illuminating effect that heretofore could only be accomplished with incandescent lamps by using a number of comparatively low candlepower units.

The accompanying distribution curve gives a graphic idea of the improvement given by the prismatic refractor. The refractor used in these lamps consists of two sections one fitting inside the other. The inner section is girdled by a succession of horizontal prisms, which converge the light rays into the most useful zone; while the outer globe is lined with a series of vertical prisms, which serve to diffuse the light. The inner surface of the interior section and the outer surface of the exterior section are smooth; therefore, both sections when placed together and the top cemented present smooth outside surfaces, which facilitate cleaning, as they do not readily gather dirt and dust.

All fixtures described are suitable for all standard commercial circuits, both series and multiple.

CHARACTERISTIC DISTRIBUTION CURVE *of 600-c.p. Mazda series lamp unit with concentric reflector and prismatic refractor.*



BRICK ROADS AND STREETS

**By John Laylin, Division Engineer,
Ohio State Highway Department, Columbus, Ohio.**

The author of this paper gives his experience in municipal and state highway improvement work in which brick has been used as the paving material, and the methods in use by the Ohio State Highway Department, at the request of the management of the Road Congress held in Chicago with the American Road Builders' Association. It is therefore an official statement of the methods and results in a state which has used more brick in both city streets and country roads than any other.

THIS paper will treat this subject largely from the writer's experience in municipal and state highway improvement work.

Ohio statutes provide for state aid in road building on a system of inter-county highways, so-called, lying wholly without the limits of municipalities, comprising a network of roads aggregating about 9,500 miles, and connecting all county seats and towns of any considerable size within the state.

The law is very flexible in regard to the distribution of costs of improvements and was designed to meet all possible conditions, but in a general way it may be stated as 50 per cent. to the state, 25 per cent. to the county, 15 per cent. to the township and 10 per cent. to abutting property. County commissioners designate the particular section of the particular inter-county highway that shall be improved in any year and guarantee the payment of costs to be levied against the county, township and property owners, and further determine the particular type of improvement to be made.

Inasmuch as the county commissioners are a party to every contract made and entered into, it may be readily understood that the highway commissioner does not select the particular type of pavement to be constructed, even if inclined to do so. Types of pavements are generally selected, however, that best suit traffic conditions and utilize suitable materials near at hand.

The highway commissioner has ever tried to treat all material and supply men with the utmost fairness, and his splendid success in the management of the department and the construction of a great highway system is largely due to the hearty co-operation of all classes of material and supply men.

After a type of pavement has been selected for a section of road to be improved, then the commissioner does insist that the construction of the work shall be of the best for that particular kind of pavement.

The essentials of a good road or street are good alinement, easy grades and perfect drainage.

Resident engineers working under the directions of department division engineers make the field surveys, plat the alinement, profiles and cross-sections, and work out all questions of new locations, grades, cross-sections, sewers and drains, bridges and culverts, and plans are made to show type and dimensions of foundation, thickness of sand cushion, kind and dimensions of curbing, kind and thickness of expansion joints, all details of drainage, bridges and culverts, and

everything not fully set forth in the general specifications of materials and workmanship.

In passing, it might be said that efforts are always made to secure a clear sight view of at least 300 feet, a maximum gradient of 8¾ per cent. and a drainage system that will maintain a water level well below the base of foundation of pavement.

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¶ THE OHIO STATE *Highway Department specifications have been carefully prepared and produce excellent pavements.*

The 1914 specifications for brick pavement improvements provide as follows:

In the preparation of the sub-grade, all muck, quicksand, soft clay and spongy materials that will not consolidate under the steam roller shall be removed, that back filling of all excavations shall be rammed in courses of not more than 6 inches of loosely filled earth, that embankments shall be built up from the bottom in successive, even layers not exceeding 12 inches in thickness, that each of these layers shall be rolled until thoroly compacted, that when the slope exceeds 2 to 1, such slope shall be furrowed before any material is placed thereon, and that areas on which embankments less than 1 foot in depth are to be placed shall be broken up by plowing or other means.

After the surface of the sub-grade has been properly shaped, the road-bed shall be thoroly rolled and compacted so that it does not wave or spring under the roller. Rolling shall be done with a self-propelled roller weighing not less than 6 tons.

Foundation for pavement may be of either portland cement concrete, old pavement, compacted broken sandstone, limestone, slag, gravel or vitrified clay.

Great care is to be used in selecting aggregates for concrete, all materials being submitted to tests to insure quality meeting requirements as specified in Bulletin No. 25, General Specifications for Materials.

Aggregates are so proportioned as will produce concrete substantially composed of 1 part cement, 2½ parts fine and 5 parts coarse aggregates, in which the mortar shall not be less than 110 per cent. of the volume of the voids in the coarse aggregates.

Coarse aggregates may consist of crushed boulders, crushed limestone, slag or gravel that will pass a screen having openings 1½ inches in diameter and be retained upon a screen having openings ¼ inch in diameter.

A cubic yard of concrete in place shall not contain less than five sacks of cement.

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¶ THE MIXING *and placing of materials and treatment of completed pavement before letting traffic on it are most important details in securing a good pavement.*

Concrete shall be mixed in a batch mixer, so-called, the drum of which shall not make less than 15 revolutions at a speed of between 15 and 20 revolutions per minute.

Materials shall be mixed sufficently wet to produce a concrete that will require no tamping. Sub-grade must be moist before concrete is placed thereon.

The surface of concrete shall be shaped by the use of a suitable template cut to conform to the crown of pavement, and shall be floated in such a manner as to thoroly compact the concrete and produce a surface the exact crown specified. The finished surface of the concrete shall conform so nearly to that indicated on the plans that it will nowhere vary more than one-half inch from the previously described templet or a 10-foot straightedge applied to the surface of the concrete and parallel with the center line of the pavement.

Care shall be taken to protect concrete from rapid drying out and freezing, and traffic is prohibited for ten days from time of laying.

A thoroly consolidated old macadam or gravel road, if of sufficient depth, may be considered satisfactory pavement foundation. The old road shall be thoroly cleaned, and, if irregular, shall be scarified, graded to the proper elevation

and all depressions filled with the same material of which the course consists. All foundation material placed must be thoroly filled, waterbound and compacted.

Rolled foundation shall consist of either gravel, broken sandstone, limestone, slag or vitrified clay. Sandstone fragments must not exceed 6 inches in greatest dimension, and all other materials must pass a screen having 4-inch circular openings and be reasonably well graded from 4 inches down to the smallest size found in the product.

Gravel shall not contain more than 15 per cent. of clay or loam.

Rolled foundation shall be constructed as a one-course waterbound macadam pavement and brought to the proper crown and grade within the limits specified for concrete foundation.

Curbing shall be either sandstone or concrete of dimensions indicated on plans and quality as specified in said Bulletin No. 25.

Sand cushion shall not contain more than 8 per cent. by weight of clay or loam. Sand shall be spread over foundation, shaped with templet, rolled till compact, and made ready to receive the paving blocks.

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¶ LAYING OF BLOCKS *and pouring of cement grout filler must be carefully and properly done or the result will be disappointing.*

Paving blocks shall be laid in an upright position upon the sand cushion, in straight courses across the road, and shall be laid so that the longitudinal joints are broken approximately at the center of each block and the long dimension of the block is perpendicular to the center line of the road on the tangents and practically parallel with the radius of curves having a radius not greater than 150 feet.

All blocks to be laid with the lugs in the same direction and set as closely together as possible. In all cases the end joints shall be made close and tight, the joints to be at right angles to top and sides. The cutting and trimming of blocks shall be done by experienced men and proper care shall be taken not to fracture or injure the part to be used.

After a sufficient number of blocks shall have been laid the pavement shall be thoroly dampened by sprinkling, and all soft, porous or unacceptable bricks will be marked by the inspector and shall be removed by the contractor. When any section shall have contained more than 10 per cent. of rejections, the blocks of the entire section shall be taken up and the cushion readjusted. As soon as possible after the blocks in the pavement are inspected, rejections removed and replaced with acceptable blocks, the surface shall be swept clean and then rolled with a self-propelled roller weighing not less than 6 tons. When rolling and ramming are completed, the surface of pavement shall conform so closely to that indicated on the plans that it will nowhere depart more than ⅜ inch from a properly formed templet or a 10-foot straight edge applied to its surface.

Soon after the pavement has been compacted and surfaced, the joints between the blocks and the curb shall be filled with a grout filler composed of one part portland cement and one part sand. Detailed specifications set forth manner of applying grout.

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¶ SPECIFICATIONS *for paving brick are standard and have demonstrated the value of years of careful work in devising and improving them.*

Paving brick specifications provide:

That the brick shall be standard wire-cut-lug or repressed paving block of standard size. The standard size of brick shall be 3½ inches in width, 4 inches in depth and 8½ inches in length. The brick shall not vary from these dimensions more than ⅛ inch in width and depth and not more than ½ inch in length, and the brick of the same shipment shall not vary more than ⅛ inch in width or depth. They must be thoroly vitrified and annealed, regular in size and shape and uniformly burned. When broken, they shall show a dense, stone-like body, free from lime, air-pockets,

cracks and marked laminations. No surface of any brick shall have kiln marks more than 3/16 inch in depth or cracks more than 3/8 inch in depth and the wearing surface of the brick shall not have kiln marks more than 1/16 inch in depth and shall be free from cracks. The brick shall have not less than four nor more than six lugs, all on one side of the brick, such that when the brick are properly laid in place in the pavement, the joints between the brick will be not less than 1/8 nor more than 1/4 inch in width. The name or trade mark of the manufacturer, if shown on such brick, must be by a recessed design or by recessed letters and not by a raised design or raised letters.

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¶ METHODS *of selecting brick for abrasion test and methods of making the test are those proposed to the American Society for Testing Materials, which are still under discussion and observation as to their sufficiency.*

If the edges of the brick are rounded, the radius shall not exceed 1/8 inch. The brick must not be chipped in such a manner that neither wearing surface remains intact or that the lower or bearing surface is reduced in area by more than .1, but such brick, if otherwise satisfactory, may be used in obtaining the necessary half brick for breaking courses and the necessary pieces of brick for closures provided that the wearing surfaces of the part of brick used shall be intact. The brick shall not be glazed. To determine whether the material of the brick as a whole possesses to a sufficient degree strength, toughness and hardness, samples of the brick shall be submitted to the rattler test. The test shall be made in accordance with the method and in a rattler as described in the recommendations by the sub-committee on paving brick to the American Society for Testing Materials. Five samples of each kiln or shipment may be selected; one sample from what appears to be the softest brick and one sample from what appears to be the hardest brick, neither of which shall lose of their weight more than 24 per cent.; and three samples representing an average of the kiln or shipment, which shall lose of their weight not more than 22 per cent.

The quality of the brick shall be of such uniformity that the range between the highest and lowest loss by abrasion shall not exceed 8 per cent. If the kiln or shipment of brick should fail to meet the above requirements, and it is fair to assume that it would meet them if not more than 10 per cent. are culled, then the contractor may, at his option, regrade the brick. When the regrading is complete, the kiln or shipment then shall be resampled and retested, as under the original conditions, and if it fails to meet any of the above requirements, it shall be finally and definitely rejected. Sampling may be done at the factory prior to shipment and brick accepted as the result of such sampling will not be rejected as a whole, but will be subject to such culling as may be necessary to meet all of the requirements except that of the rattler test.

The Ohio State Highway Commissioner let contracts for brick roads in 1912, 1913 and 1914, mileage as shown in the following table:

	1912.	1913.	1914.
Mileage brick roads contracted	33.47	27.71	164.0
Per cent. brick road of total mileage of all roads	20.7	17.7	32.5
Contract price for brick roads	$507,899.19	$486,925.87	$3,415,584.45
Per cent of total contract price of all hard surfaced roads	36.4	35.3	46.3
Average contract price per mile for brick roads	$15,680.00	$17,572.00	$20,827.00
Average contract price for brick roads per foot in width per mile	$1,150.00	$1,379.00	1,364.00

The contract price for brick roads included grading, draining, curbing and paving for the years 1912 and 1913, but also included bridges and culverts for the year 1914.

In the preparation of our plans it is our endeavor to embody the use and requirement of the best possible foundation, and the best possible drainage consistent with the economy of the road.

Following this rule, a concrete foundation for brick pavements is generally provided, and as the greatest assurance against longitudinal cracking in the wearing surface, the advantage of a dry subbase is considered essential. It is the general belief that brick pavement cracks are caused more by frost action than high temperature stresses. In fact, a sufficient and proper drainage of the sub-grade of all roads, including the brick road, is regarded as of the utmost importance. Frost has little effect where moisture is almost entirely absent; hence these provisions carefully observed are certain to reduce to a minimum all deleterious climatic effects.

There are a few examples of brick pavement construction that the writer especially desires to call to attention.

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¶ SPECIAL DESIGNS *for brick pavements are cited and success in use and beauty of appearance are indicated.*

The Cleveland-Buffalo I. C. H. No. 2, in Lake County, is a 2½-mile improvement with brick surface 18 feet in width, curbed on either side with a 24-inch concrete gutter having a 2½-inch concave surface. These gutters collect the water that falls on pavement and lawns and conduct it to catch basins connected with a system of underground drains. The pavement is laid on a 4½-inch concrete foundation. The lawns slope back from the gutters and the parklike effect is very pleasing.

Many of the brick pavements in northern Ohio on streets and roads having a sandy or gravelly soil are laid on natural bed foundations, and where traffic is light or medium such streets are giving first-class service. Many such streets have been in use 20 years and more, and they give every evidence of being good construction.

Two streets in Norwalk, Ohio, have been laid on natural bed foundations and edged with vitrified curbs. These curbs were made on a regular paving brick machine with three out of four of the cutting wires removed, thus making a block that when burned was 4 by 8½ by 15½ inches. These blocks were set with the 8½-inch dimension vertical and set in gravel or crushed limestone.

The pavement when grouted with a 1-to-2 cement mortar practically became monolithic. This work has been in place less than two years, but it looks like good, cheap pavement construction. The writer has watched for a number of years two streets in a small village that were curbed with ordinary paving block stood on end and thoroly grouted. The earth next to such blocks has worn away in places and the edges of the bricks have become rounded, but they are still doing business and holding pavement intact.

A number of Ohio roads have been designed and constructed with concrete foundation and curb constructed monolithic, and such construction is to be recommended.

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¶ ROADS ABOUT CLEVELAND, *constructed without State aid, are briefly described and the improvements in design and construction are noted.*

Cuyahoga County, Ohio, is noted for its brick country roads, there being over 350 miles outside of the City of Cleveland.

These roads have generally been constructed 14 feet in width, located on side of roadway, the balance of roadway being graded to width of 7 feet or more and used as an earth drive.

The earlier roads built were constructed with rolled foundations and not very much attention was paid to matter of drainage, but brick roads as now constructed are well drained and provided with concrete foundations. Concrete and sandstone curbing is employed, and in

all cases the pavement slopes so the surface drainage flows away from the earth track. Raised curb is often used on the outside, and on hills raised curbs are used on both sides of pavement, drainage being provided by catch basins and underground drains.

On hills, hillside block and Medina block are used.

Traffic is very heavy in and about Cuyahoga County, and the brick roads seem to have solved the road problem.

In conclusion, it may be said:

That brick roads and streets should always have a solid sub-grade, perfectly drained.

That a concrete foundation should be provided wherever traffic conditions are heavy, and that the surface of concrete foundation should be made true and smooth and exactly parallel with the crown of street.

That the sand cushion should be thoroly compact and from 1½ to 2 inches in thickness.

That a cement grout filler is the best filler.

That a brick road is a dependable road.

The paramount interest in brick roads that more greatly concerns the tax-paying public is the same that is involved in the expenditure for any road, no matter what the type, and that is the efficient building of the road itself, the compliance with the plans and specifications. The proper construction of a brick road is no more difficult than the construction of any kind of road, but every requirement of the plans and specifications should be carried out. Plans, specifications and contract presuppose that each and every requirement therein is a part and parcel of a necessary adjunct to the value of the road intended to be built. A complete co-operation of the combined influences of public sentiment, official authority and the obligation of the contractor are necessary to reach the ideal in road building. Without the combined forces of all, the most conscientious official, the most diligent contractor or an anxious public acting singly and alone can not attain the best results.

Transcontinental Automobile Routes

Late reports indicate that the road improvements on the principal cross-country lines during 1914 have been underestimated rather than overestimated. This is particularly the case on the western end of the "Northwest Trail," between Montana and Seattle, especially since the former severe grade of Snoqualmie Pass has been reduced to a maximum of 5 per cent.

Hundreds of miles of the Lincoln Highway have been improved and marked. In Ohio over three-fourths of the entire length of the route has been hard-surfaced with cement, brick or other material. In Indiana the bond issues passed by the local communities aggregate over three hundred and fifty thousand dollars. On September 16, Elkhart, Ind., opened a section of concrete Lincoln Highway 18 feet wide; work is now in progress on a 6-mile section near Fort Wayne; St. Joseph county, in which South Bend is located, has voted $175,000 for immediate improvement. Governor Dunne, of Illinois, personally began work on the Lincoln Highway in his state on April 16, by turning over the first spadeful of earth at Mooseheart, and on the 16th of June, this section was opened with appropriate ceremonies as a part of the Lincoln Highway. Five counties in Iowa have voted a total of $140,000 for Lincoln Highway improvement.

Both the "Trail to Sunset," and its principal alternate, the Santa Fe-Grand Canyon-Needles Highway, have not lagged behind the others, and, beginning next year, the tourist has two complete options between Albuquerque and southern California, both of which can be traveled with comfort and safety. The National Old Trails road has been marked from the Pacific coast to Kansas City and in sections farther east.

While, unfortunately, some parts of the "All-Southern Route" are yet in poor shape, that line as a whole has been greatly improved during 1914, and will not present very serious difficulties to tourists who decide to go leisurely across that way in 1915. The A. A. A. Touring Board has the latest information on all these lines, and is prepared to confer with tourists on the routes best suited for their particular purpose.

CONCRETE CURB AND GUTTER

AS CONSTRUCTED IN DENVER, COLO.

By E. B. Van de Greyn, Consulting Engineer.

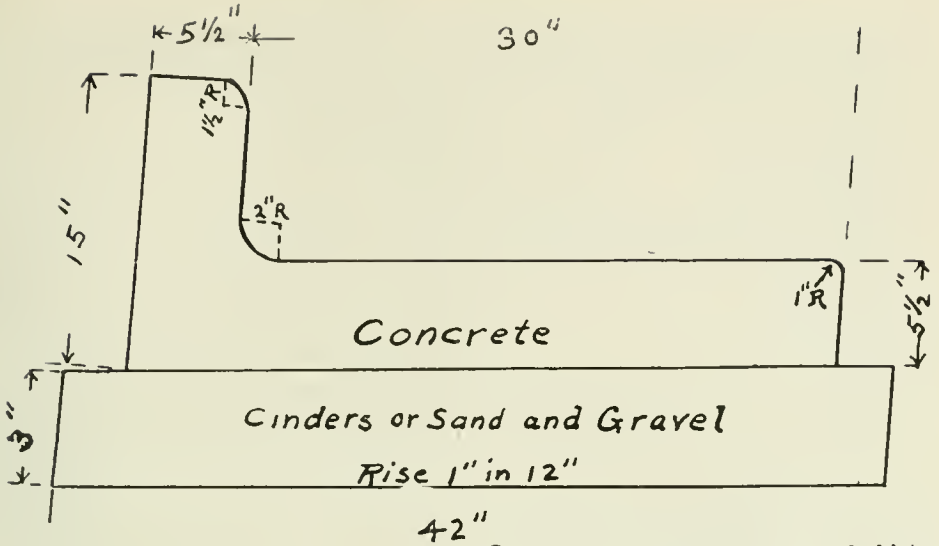
Some years ago the city of Denver, Col., introduced a method of constructing concrete curb and gutter without separate mortar facing and mortar top, which has been successful. The author of this article describes the process from his personal experience with its use in Denver and in other localities.

THE form of combined concrete curb and gutter generally constructed consists of a concrete body and a mortar coat on the exposed faces. The mortar face on the curb is secured by plastering the form board ahead of the concrete work, or it is secured by using a templet just behind the face board and after the concrete is in place and stiff enough to stand up the templet is removed and the space between the concrete and face board filled with mortar. In many instances in such work it is observed that the mortar facing checks badly and in some extreme cases the mortar falls from the body of the curb.

In the city of Denver for some time past the mortar facing and top has been dispensed with in combined concrete curb and gutter work, and the finish made directly on the concrete by proper spading and trowelling. This resulted in lessening the cost to the property owner an amount worth saving, and also resulted in work that does not show check marks. The appearance of the curb and gutter has been satisfactory enough so that there are no complaints from property owners on that score. There are, of course, the complaints that come when a contractor has a piece of work spoiled by bad workmanship or material or because of putting in concrete in freezing weather. Several hundred thousand linear feet of such solid curb and gutter have been constructed in Denver in recent years, the first of such work being started under Hon. John B. Hunter, then chief engineer of the city and county of Denver and now commissioner of public improvements. The fact that such a large amount of the curb and gutter has been constructed in the past and that more is being constructed is evidence that it has proven satisfactory to the property holders.

The proportion of the concrete used in such work should be such as to allow of an ample surplus of mortar over what is needed to fill voids in the gravel or broken stone. This excess is needed in getting a good finish on the exposed face of finished work. The proportions commonly used in Denver were 1:3:3. Recently a 1:2½:3½ mix has been adopted with good results. A finish can be secured with 1:2:4 mixture but it is not recommended because such a mixture requires more work to secure a finish and there is danger with careless workmen of not being able to get a good finish in spots. Assuming voids in stone at about 40 per cent., 1:3:3 mixture gives an excess of mortar over that required to fill voids of about 150 per cent.; in the 1:2½:3½ mixture the excess is about 80 per cent. The writer had contractors on several jobs try out various mixtures and finds those mentioned give excellent results.

The method of finishing the concrete



SECTION *of combined curb and thirty-inch gutter. An expansion joint three-sixteenths inch wide is located every six feet.*

is as follows: The concrete is mixed quite wet, i. e., to a mushy consistency, and is shoveled and tamped if needed. One man immediately strikes off the surface of gutter with a straight edge resting on the steel templets which cut the curb and gutter every six feet. This straight edge is worked back and forth forcing the stones down and leaving the mortar on top. Following this a second man works the top of the concrete with a wood float. If a smooth finish were desired in the gutter a steel float could be used. The working of concrete with trowels brings the mortar to the surface.

On the curb work the concrete is spaded thoroly along the face board and the top of curb is struck off with a straight edge in a manner similar to gutter. Following this after concrete has dried a little a man finishes top of curb with steel trowel and runs an edger over top corner of curb. As soon as concrete has set sufficiently to allow it the face board is removed from curb and the steel templets are pulled. Then the finishers run a steel edger along outside edge of gutter and on both sides of expansion joint in gutter. This gives a panel effect to each 6-foot section of gutter. Two steel trowels are used on the curb; one trowel is curved to fit top of curb and come down about half way on face of curb; the other trowel reaches halfway or more up the curb face and about 4 inches onto gutter. These trowels are bent to give the radii required at top corner of curb and juncture of curb and gutter. Occasionally a spot is found where the rock shows and this is doctored by trowelling in a little mortar. As soon as practicable after curb is finished the curb and gutter are covered and kept moist.

To illustrate the organization used on this work and what can be done the following is given for one day's work by one of the best equipped contractors. The writer was furnished the following data by The Gaffey and Keefe Construction Co. of Denver. The dimensions of curb and gutter are shown in sketch submitted herewith. Material costs were as follows:

Cement, delivered on work....$1.75 bbl.
Sand, at pit.....$0.33 cu. yd.
(One team hauled 8 cu. yds. in 8 hr. day.)
Gravel, at pit ..... .66 cu. yd.
(One team hauled 8 cu. yds. in 8 hr. day.)
Cinders, delivered, about.... .60 cu. yd.
(It might be noted here that the standard plans of the city call for cinder bed 6 inches deep, but 3 inches was used on this job.)

Equipment used on job, not including wagons for hauling concrete material, was:

1 ¾-cubic yard cube mixer.
6 1-horse concrete carts each 2/3 cubic yard capacity.
2 water wagons.
1 wagon for moving forms.
Other small tools such as shovels, barrows, concrete pan, etc.

The organization and hours of labor were as follows:

2 foremen, 8 hours each.
1 timekeeper.
1 night watchman.
2 water boys, 8 hours each.
6 1-horse carts and boy driver, 8 hours each.
1 team and driver on wagon moving forms, 8 hours each.
2 teams and drivers on water wagons, one wagon used for wetting down cinders and other wagon for keeping finished curb wet, 8 hours each.
Form setters, 27 man hours.
Helpers, 52 man hours.
Cinder men, 67 man hours.
1 gutter tamper, tamping base under cinders, 8 hours.
2 tampers, tamping cinders and concrete, 8 hours each.
Men shoveling concrete from pan into curb and gutter, 40 man hours.
1 finisher, 8 hours.
Helpers to finisher, 40 man hours.
Men wheeling gravel and sand to mixer, 48 man hours.
Man and helper feeding cement to mixer, 16 man hours.
1 engineer, 8 hours.
Labor on ditch for curb, 192 man hours.

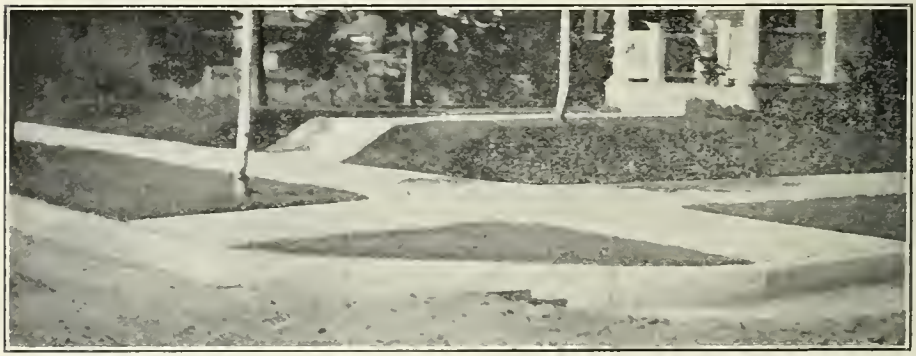
The above gang put in about 2,000 linear feet of the combined curb and gutter shown in the sketch. There is about 1.70 cubic feet of concrete per linear foot of curb, hence the 2,000 linear feet equals 126 cubic yards.

There were 88,000 linear feet of the curb and gutter in the contract and the contract price was 49 cents per linear foot. Excavation of trenches is paid for separately by the city on cubic yard basis as a part of the job if grading the street between property lines. The work of grading the street and of building curb and gutter and cross walls is all let in one contract.

Engineers reading this are cautioned about basing estimates on the price of 49 cents because the contract was taken at a time when work was slack and contractors hungry for work even at low prices to keep their men employed and their horses and equipment busy. It takes a trained organization experienced in the work to put in such a large amount as 2,000 linear feet of curb and gutter in 8 hours. The prices generally bid on this work range from 50 to 60 cents depending on length of haul of materials, labor conditions, and whether contractors are busy or not. The well equipped contractors average 1,400 to 2,000 linear feet per day of the curb and gutter work.

The view shows the good appearance of curb and gutter built as outlined above, i. e., without the regulation mortar facing.

APPEARANCE *of one-course curb and gutter on Denver street corner.*



TRAFFIC CONGESTION PROBLEM

IN BROOKLYN, N. Y.

By W. H. Messenger, Assistant Engineer in Charge.

The many complaints of congestion of traffic in the Brooklyn, New York, streets, between Boro hall and the Brooklyn bridge, and of noise about the court house, caused a survey to be made of the conditions existing, of which survey the author was in charge. A method of relief by re-routing street cars, which were found to be the main cause of delays in passage of traffic, was proposed. The paper from which this article is taken was presented before the Brooklyn Engineers' Club and contains the details of the re-routing plan. This article sets out the principles of procedure and enough of the detail of the special case is retained to indicate how these principles may be applied in any particular case.

THE rather serious congestion and delay to all surface traffic in the downtown business section of the Boro of Brooklyn, caused by a combination of factors which the writer will attempt to set forth and analyze, has been forced on the attention of the public for some time past. The city planning committee has had the question under investigation for over two years, and the results of its inquiries have been publicly shown by a series of plans, which for their execution would call for very large expenditures both now and in the future.

The Boro president of Brooklyn has, of course, been very deeply interested in this question, and has given the problem to the chief engineer of the Bureau of Highways, Mr. H. H. Schmidt, who has made reports accompanied by plans, diagrams and statistics. The collection of the traffic statistics, together with the preparation of the plans and diagrams, having been given to the writer to do, he will try here to show the methods used, the data obtained as well as some of the measures of relief proposed.

The methods used were taken from those of the general traffic census of the Boro, and in order to best bring out these methods, a description of that census is given. The traffic census of the Boro was organized some three years ago for the purpose of finding the traffic density and tonnage thruout the Boro, as a guide in the design of pavements and for various other purposes. The locations at which observations were made during the year 1913, took in, as far as possible all the important and typical paved streets of the Boro. The work goes on thruout the year, with the exception of the months of January, February and March, when the weather conditions are generally such as to make the results that might then be obtained of very little value.

The records are taken by a corps of observers composed of one foreman and from 6 to 12 laborers, working rain or shine every day, Sundays and holidays only being excepted. The working hours are 8, from 8 a. m. to noon and from 1 to 5 p. m. Usually three records are taken at each location, with 15 day intervals between, so as to vary the day of the week. With the force available, from

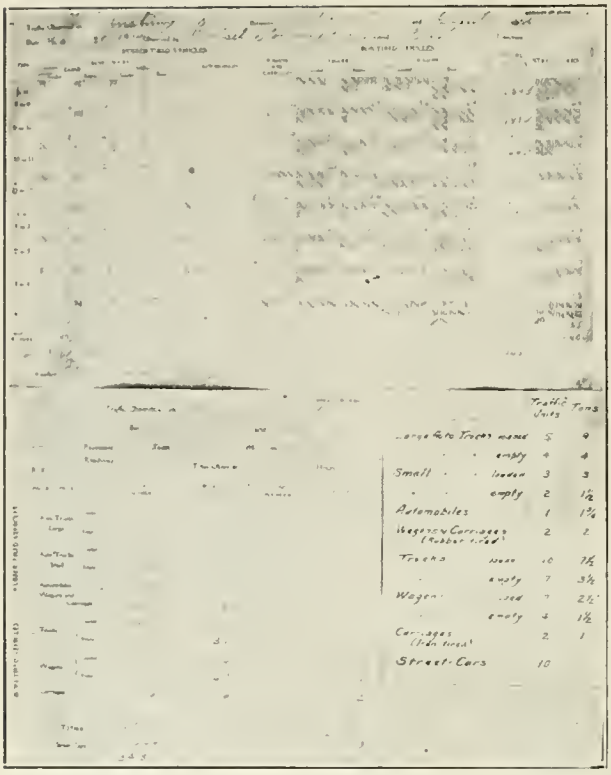


FIGURE I. *Enumeration of traffic units and tonnage for each class of vehicle enumerated, being a sample of an ordinary day's observation card and report summary.*

600 to 800 different locations are observed each year. The points of observation are so planned that a fairly accurate estimate can be made of the traffic density and tonnage in any given street or district. Where it is impossible to estimate by interpolation the data for a given street, special observations are made as required. While the largest part of all records are of 8 hours, some 16 and 24-hour continuous records are taken at different times and places, so that a fair ratio between the day traffic and that for the full 24 hours is obtained, this last item being used principally to obtain the tonnage per annum.

As the density of traffic is dependent on the size, speed and flexibility of the vehicles passing any given point, any analysis that will give an adequate measure of these quantities is of the first importance. Such a measure has been found and used in its work by the traffic branch of the London County Council. This measure is in the form of a factor or co-efficient, having a relation to the size, speed and flexibility of the vehicle, and is called a traffic unit. Applying each of these factors to the various classes of vehicles enumerated, a figure is obtained which, when reduced to the number of traffic units per hour or per minute per foot of available width of roadway, gives a reasonable estimate of the traffic density. In so doing this method also provides a common basis for comparison of the densities of traffic in widely different streets in the same city or in different cities and countries. The above reference to available width of roadway means the net width after deducting the width of the bases of elevated columns, isles of safety or any other fixed obstructions within the roadway.

The traffic tonnage, together with the class of the vehicles borne by the street, is of considerable importance in determining the character of the pavement to be used. Even where pavement openings are quite numerous, the wear and tear is a big factor in the life of the pavement, provided always that restoration after opening is done with a reasonable degree of care. The weights here used were compiled after an extensive inquiry from many sources, including the largest shippers of goods and construction materials. Tables of traffic units and tonnage for each class of vehicle enumerated are here shown, Fig. 1, as well as a sample of an ordinary day's observations, together with a re-

port summary. The factors for traffic units, owing to the variable nature of the traffic and the intermingling of fast and slow vehicles, both loaded and empty, were not arrived at by computation but were established largely by observation. The figure 10 for street cars, owing to the size of the same and their being fixed rigidly in their line of travel, seems entirely reasonable. The same figure for trucks driving two or more horses might be considered large by some, but when it is remembered that this class includes a large variety of vehicles, such as moving vans, drays and trucks for lumber, coal, building and construction materials, frequently driving three horses, it is believed to be fair.

The weights used here are, of course, inclusive in every class of vehicle, including the weight of vehicle, the load, driver, horses, etc. The figure 9 tons for large auto-trucks loaded may appear to be rather above the mean for our heaviest class of motor-driven vehicle, but it must be remembered that there are a number of such vehicles in use with that number growing rapidly. There are a number of tractors with trailers now in use which weigh, with load, all told, 15 tons. It is necessary to thus dwell somewhat on these two tables, for upon them depends to a large extent the inquiry preceding pavement designs, based on a traffic census.

The assembling and indexing of the data secured are shown in Fig. 2. This index card gives a column for each of the quantities most used, except that of the percentage of motor-driven vehicles excluding street cars, which is placed in the remark column to the right. This card provides space for the entry of four or five years' records, thus providing a convenient traffic history of the street given. Some reports elsewhere have included a column for the number of vehicles per line of traffic, allowing about 8 feet per line. The writer does not believe this provides a good comparison for the densities on a number of streets the widths of roadway of which do not even nearly correspond to some even multiple of 8. For instance, the roadway of Fulton street, between Boro Hall and Flatbush avenue, is 42 feet, of which two lines of street cars require from out-to-out, 19 feet, leaving 11.5 feet for passage of vehicles on either side. This space is more than ample for one line of traffic on each side of the street cars, but not sufficient for two lines. In other words, the width of the roadway in excess of 34 or 35 feet is of so little value as to be negligible. Before the advent of our largest street cars and the increase in size of almost all other vehicles there may have been room for six lines of traffic in this roadway space provided for us by our ancestors, that is, if they gave such a matter any thought, which is doubtful. Nowadays, however, for such capacity a width of at least 50 feet is necessary. A glance at Livingston stret in the same vicinity shows this to be unquestionable. This, of course, brings out the fact that if Fulton street could have its roadway widened 4 feet on each side, for instance when the elevated railroad is reconstructed, an additional line of traffic in each direction could be accommodated, to the very great benefit of the public, particularly that fairly large portion of it doing business in the vicinity.

To revert once more to tonnage, it has

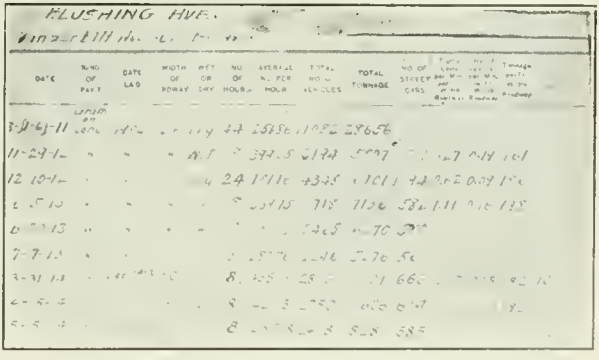


FIGURE 11. *Index card, giving summary of data for point on Flushing avenue, affording room for records for several years.*

FIGURE III. *Map of the Brooklyn down-town district, the black dots showing the points of observation of traffic conditions.*

become quite the custom by some to refer to certain classes of pavements as being suitable for so many thousand tons per foot width per annum. It seems rather premature to attempt to make such an assumption until it has been proven after the lapse of the necessary time, that such pavement has actually lived its normal life under such a traffic. In other words, it would seem to be far safer to wait until we have a complete history of the given pavement which has actually worn out, especially its traffic-tonnage, before we can assume either the tonnage a given pavement will bear most efficiently, or the pavement most suitable for a given tonnage.

On some streets, due to width of roadway or location of and kind of street car rails, vehicles have a tendency to keep to one line, thereby gradually forming ruts, tending to the quick destruction of the pavement surface. This can hardly be avoided, but can be somewhat ameliorated by laws which fix the maximum loads per axle and the minimum widths of tires and diameters of wheels.

With some regard for the foregoing, we will now look at the special problem of congestion of all traffic in downtown Brooklyn. This problem was brought up very forcibly by the request of the court house commission that all street cars be eliminated from Joralemon street between Court and Fulton streets and from Livingston street between Court street and Boerum place. At or about the same time the proposition was advanced to remove the elevated railroad entirely from lower Fulton street, turning it into Adams street at about Boerum place and running thence to the present turn into the Brooklyn bridge terminal north of Tillary street. This will probably call for a double-deck structure from Myrtle avenue northerly. Adams street it is proposed to widen by taking about 100 feet on its easterly side. To make this 'L' turn it is proposed to take a part or all of the small triangular block between Fulton, Willoughby and Pearl streets. Of course, this whole proposition is part and parcel of the proposed improvement of the district between Boro Hall and Brooklyn Bridge. But with regard to surface traffic strictly, it may be possible to meet the desires of the court house commission and also partly remove the existing congestion and delay in this vicinity. To study this question properly, we, first of all, took a series of 16-hour traffic records at a number of important points in the district affected. These observations were taken between 6 a. m. and 10 p. m., subdivided into 15-minute intervals, the observers working continuously, in two shifts, two men at each point per shift. The points of observation are shown on the map of the downtown district by circles, Fig. 3. From these data, collected on a form shown in Fig. 4, were obtained the route and destination of every street car passing thru the district in each direction as well as the ordinary vehicular census. After computation of the results and plot-

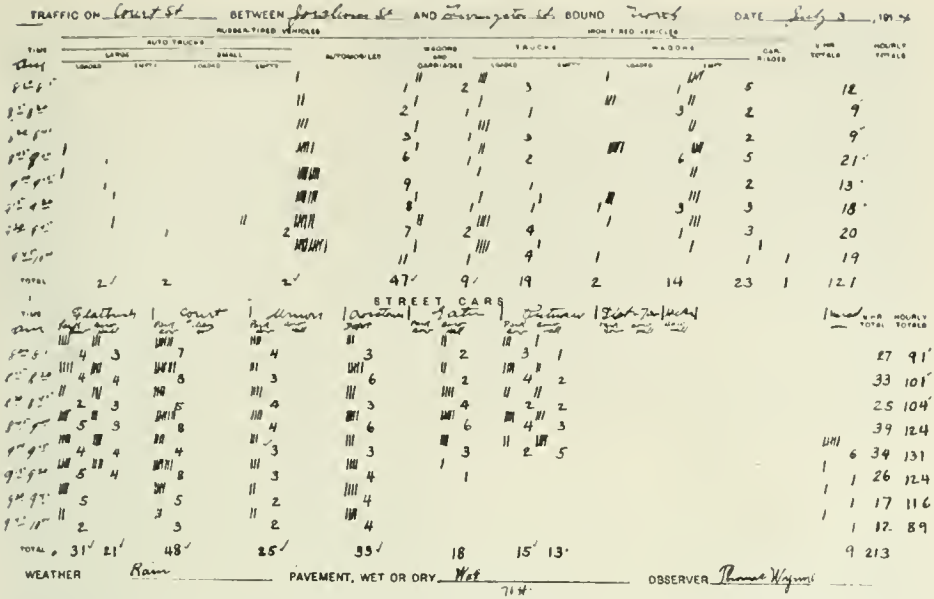


FIGURE IV. *Traffic count in Court street, showing route, direction and destination of every street car passing, as well as number of each class of vehicle.*

ting of the same we were in possession of the data to show the location and hour of greatest traffic density. This inquiry was supplemented by a few photographs, as follows, Fig. 5 being the first of these and indicating the nature of the information furnished by them:

Flatbush avenue, from State street to Fourth avenue, looking north; Flatbush

FIGURE V. *Photograph of Flatbush avenue from State street to Fourth avenue, indicating the nature of information given by photographs taken at listed stations.*

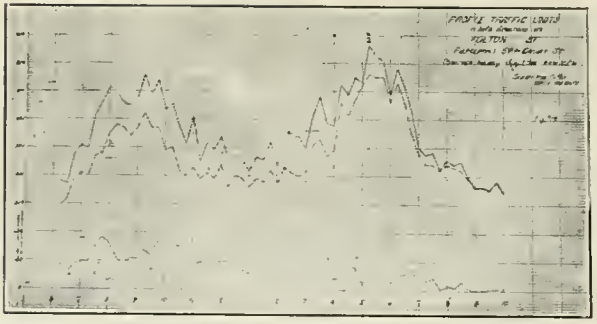


FIGURE VI. *Profile showing number of traffic units passing in each direction on Fulton street, from Pierrepont to Court street.*

avenne and Nevins street, looking north; Court street, from Remsen street to Joralemon street, looking north; Flatbush avenue, from Pacific street to Fifth avenue, looking north; Fulton street, at Bridge street, looking west; Fulton street, at intersection of Adams and Willoughby streets, looking west; Atlantic avenue, from Flatbush avenue to Fifth avenue, looking west; Court street, from Joralemon street to Livingston street, looking north; Court street, from Montague street to Remsen, looking north; Fulton street, at Pearl street, looking west; Fulton street, at Myrtle avenue, looking north.

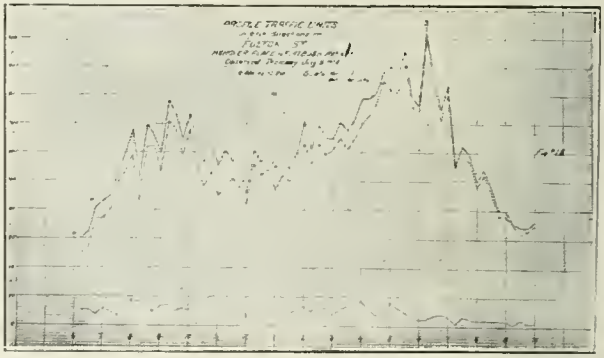
From the data thus obtained an analysis of the density and direction of all traffic was obtained and its control studied, first to obtain the particular results required by the court house commission, and second to reduce the congestion at certain important points; all of which must be done, of course, without serious reduction of the facilities now given the public nor at any very great expense.

From the profiles shown, it is easily seen that the congestion problem is one of street cars, the ordinary vehicular traffic being insignificant in comparison. From the rush-hour data is obtained a table of street car movements in both directions about as shown in Fig. 9. These are in numbers only, and in the adjoining column are the approximate figures obtained from the re-routing of street cars to overcome the difficulties complained of.

From the table in Fig. 9 we see the number of cars now passing the points given in both directions from 5 to 6 p. m. and in the adjacent columns the number called for by the proposed re-routing, together with the differences in number and percentages of reduction or increase as the case may be. By profiles it has been demonstrated what a large proportion of the total traffic density is due to street cars, therefore it seems fair to claim that a material reduction in numbers of the latter will achieve the desired result.

While the reduction of the amount of street car traffic at the most essential points may seem niggardly in this proposal, attention is drawn to the elimination of certain very bad intersections now existing, where it is believed a very material improvement can be expected.

FIGURE VII. *Profile of traffic units passing in each direction on Fulton street, from Hanover Place to Flatbush avenue.*



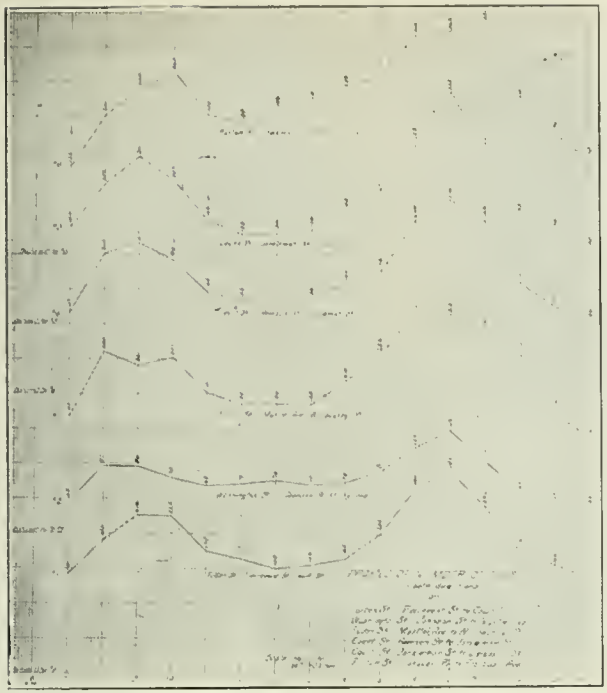


FIGURE VIII. *Profile of the number of cars passing in each direction on six streets on which observations were taken.*

Referring to the map, Fig. 3, the present crossing at Joralemon, Fulton and Willoughby sts. will be removed, as well as that at Fulton and Adams sts. and Boerum pl. The remaining northbound Park Row cars on Fulton st. between Myrtle ave. and Willoughby st. will continue straight north on Fulton st. instead of dividing as now, some proceeding north on Washington st. The third track on Court st. at Boro Hall likewise disappears.

Naturally enough these proposals do not consider the various questions, more or less legal in their nature, of trackage and franchise rights, but it is believed that, since the larger part of the rights of way, etc., are now under one control, it would not be difficult for the railway men and the city authorities to come to some agreement on the matter, equitable to all. Also this plan does not wait for the very large proposals for an approach to Brooklyn bridge to be worked out in their full detail. This plan does, however, offer a solution that can be quickly utilized as soon as the court house and elevated railroad problems are determined.

As regards this surface transit problem in general it is believed to be no worse than that encountered and solved in several other cities, of even much less population. The beginning of the now very comprehensive rapid transit system of Boston was the placing of its street cars in a subway under Tremont st. thru the center of the city. The city of Newark, New Jersey, has been able to obtain the construction of a large terminal for the relief of the public and better street car operation thru its streets.

FIGURE IX. *Table showing number of cars passing in each and both directions at fifteen points of observation and the number that would pass under re-routing plan, with increase or decrease in each case.*

Street	Limits	Existing			Proposed			Diff.	Per Cent.
		N. & E. Bound	S. & W. Bound	Total	N. & E. Bound	S. & W. Bound	Total		
Fulton St	Pierrepont - Court Sts	119	173	292	93	109	202	89	30
Washington St	Johnson St - Myrtle Av.	101	68	169	67	55	122	25	17
Boerum Pl	Fulton St - Livingston St	37	42	79	87	60	147	+68	+86
Adams St	Myrtle Av. - Willoughby St	37	49	86	27	7	34	-52	60
Court St	Joralemon - Livingston Sts	140	195	335	69	76	125	-210	-63
Fulton St	Myrtle Av. - Willoughby St	214	101	315	70	63	133	-182	-58
Fulton St	Hoyt St - Elm Pl	222	187	409	180	188	368	-41	-10
Fulton St	Pearl - Jay Sts	209	157	366	144	143	286	-80	-22
Flatbush Av. Extn	Myrtle Av. - Willoughby St	55	58	113	96	96	192	+79	+70
Concord St	Washington - Adams Sts	23	19	42	21	97	120	+78	+86
Johnson St	Fulton - Washington Sts				34		34	+34	
Myrtle Av.	Washington - Adams Sts	23	27	50	69	69	138	+88	+176
Sands St	Washington - Adams Sts	111	104	215	80	80	160	-55	-26
Jay St	Willoughby - Fulton Sts	32	32	64	102	102	204	+140	+219
High St	Washington - Adams Sts	52	31	83	74	-	74	-9	-11

Concrete bridge built by Fulton county, Georgia, convicts. Forty feet span, sixty feet width.

CONVICT LABOR ON COUNTRY ROADS

By George C. Warren, Boston, Mass.

The arguments in favor of using county jail and state prison inmates as laborers on construction and maintenance of country roads are forcibly put in an article prepared for the General Federation of Women's Clubs, from which this article is taken. Fulton county, Georgia, work is set forth in some detail because the author has means of knowing how that work is done.

IN these days of modern improvement, perhaps there is no economic question of greater importance or receiving more earnest consideration than that of more humane, industrial treatment of the unfortunate convicts and of making them more useful members of society.

The evils of contracting convict labor at low prices to manufacturers for producing goods for sale on the market, in competition with similar products manufactured by free labor, which was in general vogue in our State penitentiaries and county jails, have come to be well recognized and the practice quite generally abandoned. Labor organizations and others did well in their opposition to the contract convict labor system, but in their extreme opposition, they have at times improperly opposed all labor of convicts. As a result there has followed a period of maintaining the convict either in absolute idleness or not permitting him to perform work in the production of articles of which he can see a use. This is still the practice in many institutions. About twelve years ago it was the writer's privilege to spend a half day under favorable auspices in going thru the Elmira (N. Y.) Reformatory, which had the reputation, doubtless well earned, of being one of the best managed reformatories in the country. It was heart-rending to see the convicts taking their daily exercise, marching in line, back and forth, thru the prison yard. The yard was unpaved and consisted of compacted gravel. Occasionally a piece of gravel would become loosened and the duty of a convict, on seeing such a piece of loose gravel, was to pick it up and put it in his pocket. After the exercise of

PEACHTREE STREET, *near Eighth street, Atlanta, Ga., paved with bitulithic by Fulton county convict labor.*

an hour or so was over and before returning to their cells, the men would empty their pockets into a receptacle for the purpose. How nearly useless and how degrading is such employment! No work for production of goods for sale was permitted under the law, but the effort was made to teach men trades—carpentry, brick masonry, blacksmithing, etc. The men learning masonry, for instance, would one day build a wall about ten feet long and ten feet high, which the next day they would tear down and rebuild, going thru this operation in a little enclosure day after day. Could anything be designed which would be destined to cause a greater loathing for the brick mason's trade thus taught, than this perpetual accomplishing no useful end other than the mechanical education which, being enforced, the average convict probably does not appreciate?

But the most pitiable condition is when the convicts are released, after months or years of close confinement, as is still the custom in most of the penal institutions of the country, in a nearly dark, poorly ventilated cell; released with a grudge against the world; sullen in temper; sallow in complexion; broken down in health from sedentary habits and lack of work; given a very poor uniform suit of clothes, a few dollars in his pockets and thrown on the world, generally without friends, to find a job. The first question asked of an applicant for work is reference to his last employer. He must either lie, and probably be caught in the lie, or face the fact that ninety-nine times out of a hundred the prospective employer, even if he had a job to offer, will not trust it to a convict.

Is it any wonder that convicts, released under such conditions, take the little money given them by the State on release, and either make straight for the saloon or gambling den, if that has been their past infirmity, or use it to get a supply of burglar's tools, if their past efficiency has been along the burglary line?

As a result of the general introduction of automobiles, both for pleasure and business purposes, with their destructive effect on the old types of road, the country is fast awakening to a realization of the fact that the country roads of the future must be as substantially built as city pavements.

In fact, the narrow country-road thorofare today carries a greater traffic per foot of width of improved area than fully three-fourths of the wider streets of any city. Congress has just passed a bill appropriating $5,000,000 per annum as a national aid to maintenance of State roads, but that large appropriation is not a drop in the bucket. The National Highways Association is energetically advocating the building by the Federal Government of 55,000 miles of highly improved country roads, including several stretches from the Atlantic to the Pacific, and from Canada to the Gulf of Mexico or Mexican border. Such national highways it is proposed should be built, maintained and owned by the Federal Government, leaving the states, counties and townships to build feeders into the national highways. Such a system of national highways, if well built, would cost approximately $800,000,000.

The state of New York alone has just completed the expenditure of an appropriation of $50,000,000. With this vast expenditure the New York State roads are as yet scarcely scratched over. Generally speaking, the work done has proved unsatisfactory and is rapidly deteriorating because it has been done too cheaply, in an effort to make the expenditure go as far as possible—much farther than it can be spread to meet the exacting conditions of the modern motor car and motor trucks.

Other states are rapidly adopting appropriations of corresponding large amounts as New York.

This immense development of modern country road construction and maintenance is a new industry—one for which a vastly increased amount of labor is

QUARRYING ROCK *in excavation for forty-foot roadway, with twenty-foot cutting, with Fulton county, Georgia, convict labor.*

GRADING *country road in Fulton county, Georgia, by convicts.*

being required. It, therefore, does not compete with present employment of labor. Labor thus employed is not in the manufacture of articles for sale and thus put in competition with the product of other laborers. The national, state, county or township roads are built at the expense of the public, for the public use, and not for sale to anyone. What more fitting employment could there be for convict labor as far as such convict labor is available? On such employment the men would have good air, good useful exercise, and could each day see the product of their labor performing a use, which is a most important consideration to the moral welfare of the men after they have completed their sentences. On release they will have learned a trade at which they can immediately get employment on other roads without the ignominy of being asked where last employed. With that fair start each man would advance on his merits with his new employer and his past employment would be forgotten. In short, the ex-convict would be given a fair chance and a new start in the world, which he never can get under the convict system now in vogue.

This is no idle dream. It has been practically tried out in Colorado, New York, Washington, Oregon and other states, to a sufficient extent to prove beyond peradventure that it is practicable. In many cases, where the convicts are put on their honor, they respect the honor and become better and more industrious convicts and are destined to become better citizens on return to freedom.

Reports are published that in Missouri and elsewhere a certain amount per day of employment of the convict is paid to his family, so that he is thus enabled to contribute to the support of his family while in confinement. What an immense advantage that is to the convict's moral condition!

I don't know that it has been tried, but it seems to me entirely practicable to set aside for the benefit of the convict a certain amount of money per day of time employed while under sentence. It is suggested that the amount should be a reasonably full measure of the value of his service, less the cost of his support in confinement. Under wise supervision portions of such earnings should go to the family of the convict, if required for their reasonably comfortable support, and as much as possible set aside in a savings bank at interest so that when the convict is released the head of the penal institution can say to him, "You have been industriously employed....days and earned over the cost of your board $.....of which $.....has been given to your family for its support and here is a savings bank account for $.....covering the balance with interest. Engage yourself in some useful employment and the Lord will be with you in your effort to be a useful, industrious member of society." Contrast such a release with the present custom of setting an ex-convict adrift with a poor

CONVICTS *in Fulton county, Georgia, spreading Warrenite road surface.*

suit of uniform cloth, which immediately marks him as an ex-convict, and five dollars in his pocket with which to find his bearings.

An interesting article in the *Century Magazine*, entitled "The Next Step in Prison Reform," gives in detail a most interesting plan adopted in the Ohio State Reformatory under which convicts who are believed to be worthy of the trust are given employment on the prison farm, without physical restraint. When thus put on the farm the convict is handed a bond signed by the convict as principal and by the general superintendent of the reformatory as surety, the conditions of the obligation being as follows:

"Now if the said John Doe, Serial Number 5656, shall well and faithfully execute the trust thus reposed in him and shall observe and obey all the rules and regulations governing said trust, then this obligation with all penalties provided for in the rules and regulations shall be void, and on the release of said John Doe on parole from the Ohio State Reformatory, he shall be given this bond to keep and to hold as positive evidence to all concerned, not only of his good record as an inmate of the reformatory, but that he enjoyed the confidence and faith of the management on the grounds that in all things he conducted himself as becomes a man and a good citizen.

Witness our hands this 20th day of November, A. D., 1913.

John Doe,
(Principal.)
J. H. Leonard,
(Surety.)

Bonds like these are used when permitting an inmate of the reformatory to join the group of men who are employed without any physical restraint whatever, that is, when a man undertakes to regulate his conduct by inhibitory forces rather than to be subject of prohibitory stress. Since this system was instituted, ten years ago, the superintendent has signed more than 2,600 such bonds, and only eighteen of this number have been dishonored.

At the same time the convict is handed a pass which reads as follows:

ROLLING *Warrenite road surface in Fulton county, Georgia, using convict labor.*

"In giving you this pass, I give you my confidence. I am sure you will fully appreciate this opportunity to demonstrate not only to me, but to the board of managers and to your friends who await your restoration to freedom that you have the self-control, the respect for law, and the proper regard for your word of honor that justifies us in permitting you such a large measure of freedom. Remember, when tempted, that trustworthiness is the red-book of character."

It is reported by Mr. Barry that:

"During the ten years that the system has been in operation in the Ohio reformatory twenty-six hundred prisoners have been allowed to work in the open without guard. Only eighteen have ever attempted to escape. The others preferred their healthy, interesting work in the open, and the bond and the card."

Fulton county, Ga., surrounds and includes the city of Atlanta, as Allegheny county, Pa., surrounds and includes Pittsburg. On account of the large assessed valuation of these large, enterprising cities, the counties are highly favored in the moneys available for road construction and maintenance, in consequence of which they have always been in the foreground of communities having a large mileage of high-grade road construction well maintained.

Fulton county has for many years employed its convicts exclusively in its highway construction. It has been the privilege and pleasure of the writer to closely follow this convict-labor highway

REINFORCED CONCRETE PIPE, 48 *inches in diameter, made by Fulton county, Georgia, convicts.*

construction in Fulton county, which not only includes the building of roads, but also the quarrying of stone for use in the roads and concrete construction, the building of concrete bridges and bridge abutments, laying of sewers, manufacture of cement concrete pipe, street grading, etc. In short, everything which is required in high-class road construction which can be built locally.

The writer is indebted to Mr. W. T. Wilson, C. E., engineer of Fulton county, for a series of photographs incorporated with this article, illustrating the convicts at work and the completed works constructed by convict labor.

It will be noticed by the photographs that in this case the convicts are all negroes and are in the usual striped uniform of penal institutions. It has been claimed by some that the striped clothing and their marking of the men is degrading and unnecessary. This is a matter of detail which could be easily changed if best and safe. Perhaps in this and other respects different treatment of white men in the North can be practiced than is practicable with colored convicts of the South. However this may be, there can be no question that, whatever the clothing, work on the public highway is far less degrading than idleness in a prison cell. Fulton county has several camps in different sections of the county where the convicts engaged in road construction are fed and housed in tents.

On the question of white vs. colored convicts, Mr. Barry, referring to a case of extreme cruelty practiced in a prison in Richmond, Tex., thru dark cell incarceration and flogging, says necessity for the treatment was claimed by the authorities because "the negro criminal was more difficult to deal with than any other kind, that he was less amenable to reason or restraint, and that he could be reached only thru his epidermis or his primitive imagination, which recoiled at the dark."

If it is true, as thus claimed, that negro criminals are most difficult to deal with, then Fulton county has solved the problem of outdoor employment under the most difficult conditions.

The following facts are gleaned from the most interesting and valuable "Annual Report of the Chairman of the Board of Commissioners of Roads and Revenues of Fulton County, Ga., for year ended December 31, 1913, by Shelby Smith, Chairman Board of County Commissioners":

"There had been an average of 680

CONCRETE SEWER *of fourteen feet diameter, built by Fulton county, Georgia, convicts.*

male convicts under control of the county during the year 1913, and they have been engaged on the public works of the county and the city of Atlanta....The total estimate of work done by the department amounts to $766,340.87."

The amount of work of several classes by the employment of convict labor during the year 1913 is officially reported as follows:

Roads graded during 1913, 16.9 miles, and miscellaneous grading, at a cost of.....	$105,404.98
Roads paved during 1913, 9.13 miles, at a cost of.....	185,007.65
Roads resurfaced during 1913, 3.55 miles, at a cost of.....	10,152.10
Roads oiled during 1913, 50.64 miles, at a cost of.....	27,427.92
21 bridges rebuilt and repaired during 1913, at a cost of....	7,744.93
General road repair.....	49,640.00
	$385,377.58

"Of a total of 640 prisoners confined for month or period ending December 24, 1913, there were only four under the care of the physician."

"The Board authorized the committee on public works to install shower baths at the county barracks for the use of the convicts."

OUTLET *of trunk sewer of fourteen feet diameter, built by Fulton county, Georgia, convicts.*

The National Free Labor Association, having its offices at 832 Broadway, New York, has published a 50-page bulletin, "Road Making by Convict Labor," which contains a series of extremely interesting articles and statistics and excerpts from reports and laws on this important subject. The following extracts are of special interest: An article by Julian Leavitt, "Good Roads and Better Men," contains the following:

Good roads are a crying necessity in this country. But until now the cost of building them has been prohibitive. We have scarcely begun to realize that in our 1,400 prison houses we have stored the labor power of 100,000 men and boys, truly an army of liberation if only applied to good purpose. I have shown elsewhere how this great mass of human energy is permitted to degenerate in the cell until it poisons not only the immediate victim, but the rest of society. Now let me tell a pleasanter story of how a few wise administrations have begun to harness this force to a great communal purpose."

Then follows statistical information from Colorado, Montana, Oregon, Maryland, Georgia, Louisiana, New York, New Jersey, Arizona, Missouri, Kansas, California, Ohio and Vermont, all of which states have successfully tried out the employment of convict labor on the country roads. The article concludes with the following:

"Here, then, is a complete road program for any state:

"First, abolish the contract system, both in the prison and on your roads.

"Second, classify your prisoners into three groups.

"A. The honor group, consisting of trustworthy, good-conduct men, whose sentences are short or within sight of expiration date—i. e., the tried men who have little to gain and much to lose by attempting to escape.

"These men may be put on road work anywhere within the state.

"B. The trusty group, consisting of good-conduct men whose sentences are

long and far distant from expiration date —i. e., men to whom the temptation to escape may appeal powerfully, but who have demonstrated some capacity to resist it.

"These men may be put on road work in the vicinity of the prison.

"C. The remainder, who cannot be trusted.

"These men may crush rock and prepare the road material for the use of the other groups, but within the prison walls.

"Third, organize your road forces with the advice and under the superintendence of competent road engineers from the State Highway Department.

"Fourth, co-operate with the county authorities by exchanging prison labor for county food and equipment."

An article, "Solution of the Convict Labor Problem," contains the following:

"At its biennial convention in 1912, the General Federation of Women's Clubs passed a resolution declaring itself 'as opposed to the contract system of prison labor, and to every other system which exploits this labor to the detriment of the prisoner; and that we urge upon the several states the advisability of establishing outdoor work for able-bodied convicts, remedial care for the feeble and degenerate, and industrial education for all who have the potentiality for reform ....The product of the convict's labor should be consumed by the state, and the profit therefrom, above the just cost of his keep, should be used to support such dependent family as he may have."

The New York State Commission of Prisons reports:

"Your committee believes that road building by the convicts, if it receives the co-operation of the officials and the men in charge, can be made profitable to the county and town, and at the same time show earnings for the penitentiary greater than heretofore shown."

Col. Edwin A. Stevens, State Road Commissioner of New Jersey, after one season's trial of convict labor on the roads of his state, is enthusiastic in endorsing the policy generally. In a communication to the A. A. A. National Good Roads Board, the Commissioner writes:

ELIMINATING GRADE CROSSING *by lowering grade of highway, work done by Fulton county, Georgia, convict labor.*

"The experiment of convict labor on state roads, which was proved to be a success in one week, is only the beginning of good road building beyond what we already have and at a price which will spread out the money of the state beyond its present confines."

The attitude of organized labor toward road building by convicts is shown by the following facts:

President Gompers, of the American Federation of Labor, says: "Prisoners should be employed at useful and practical productive toil. The labor of the state's unfortunates and derelicts should never be exploited for profit, and certainly never for the private profit of contractors. Let our states employ their prisoners in the production of the necessaries of life, for the maintenance of themselves and the inmates of the other state eleemosynary institutions, or else road building."

John J. Sonstesy, of the United Garment Workers, in the Proceedings of the National Conference of Charities and Correction, 1912, page 222, says, in regard to the question of road building by convicts:

"Many people think that the only alternative to abolishing the contract or lease system is idleness for the convicts. That this is not true has been proved in the places where the contract and lease

systems have been abolished. Every convict who has no trade and is capable of learning one should be taught one most suitable for him, to make him an efficient, intelligent mechanic, and able to follow the trade when he is released. In the arrangement of employment for the prisoners the state should endeavor to supply itself with everything necessary in its various institutions. A large farm should be operated, and all other necessary plants for the turning of the different raw products into the finished articles needed in the various state institutions. The making of roads is an ideal occupation for convicts."

The New Jersey Federation of Labor passed the following resolution:

"Resolved, That the New Jersey Federation of Labor urges upon Fielder, so far as he is able, to develop the state use and road work system, and so far as possible continue the policy laid down by his predecessor, President Wilson, on this important subject, and they request him to refuse to renew or execute any new contracts for the work of prisoners or permit the present contracts to be extended."

John P. Frey, of the International Molders' Journal, says:

"The trade-unions have never advocated that convicts should be kept in idleness, instead they have insisted that convicts should be employed and that the convict's reformation would be impossible without useful and healthful labor...

"It is not the work of the convicts as producers which meets with trade-union opposition, or that by working they may keep some free men idle. It is the methods by which prison labor, when performed for the benefit of private contractors, places the convicts' labor on the market, and thereby forces reductions in wages upon large numbers of free workmen and, by so doing, lowers their standard of living.....

"For years the trade-unions have endeavored to have the convicts employed out of doors as much as possible, where the sunshine and pure air would build up the physical man and give that rugged health which would enable the unfortunates upon their release to have clear heads and strong bodies, instead of being the pallid wrecks which so often leave the prison door, nerveless, spineless and unfit to undertake the task of reclaiming their places as useful members of society or to properly support themselves thru their labor.

"The trade-unions insist that convicts shall be employed, but they are equally insistent that their labor shall be performed under conditions which will tend primarily toward their reformation....

"There is much work requiring the use of both brain and hands which is necessary in connection with the maintaining of our state and eleemosynary institutions which could and should be done by convicts. There are highways to build, there is farm produce to be provided and the convicts can do all of this with a minimum of competition with free labor and with no injury to the farmer.

"For this work the convict should be paid by the state so that he may be made to realize that the state does not rob him of his labor, a common impression among the convicts today, but that his confinement has been made necessary for his own good and the safety of society, and that during this confinement society is discharging its obligations to him, giving him an opportunity of reformation, and enabling him to earn money which will save him from actual

CONCRETE ABUTMENTS *built by Fulton county, Georgia, convicts in eliminating grade crossings.*

want upon his release, and what is equally important, enable him during confinement to provide for those who are dependent upon him and who without his assistance are forced in many instances to depend upon private charity."

Referring again to Fulton county, the experience proves that the very highest and most modern types of road construction requiring expert labor and technical skill can be built successfully with convict labor at a minimum cost. The types of road which can be most economically built by convict labor are those which are made as largely as possible of crushed rock. The manufacture of road materials at penitentiaries, shipping the materials thus manufactured by rail to point of use, is undesirable and uneconomical because:

First—Such types of roads require an undesirably heavy investment in manufacturing plant.

Second—An unnecessary and heavy outlay of cash is necessary in transportation of the manufactured product from the penitentiary to the point of use.

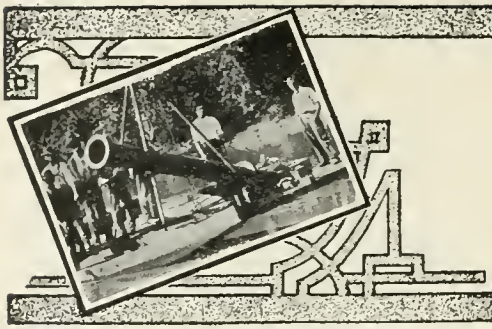
The entire tools and machinery of Fulton county employed by its public works department, including quarry and street tools, wagons, grading outfits, steam rollers and complete Warrenite mixing plant, is inventoried at only $50,500, with which, as noted above, it completed public works in 1913 aggregating $385,377, so that the road construction of 1913 aggregated nearly eight times the value of equipment used thereon.

Of course, it must be borne in mind that convicts who are physically incapacitated, either because of age or other infirmity, or because of lack of prior muscular development, cannot be well put at manual labor. As someone has said: "You cannot suddenly turn a bank president into a laborer with a pick and shovel, and expect him to perform much work." In road construction, ever, there is a great deal of employment which is not manual labor, such as time-keepers, material men, watchmen, etc., and it is believed that, as in the business world of free labor, a place can be found on road construction for all classes of convicts, each placed in the department of the work which he is best fitted to fill.

In conclusion, if the entire 100,000 men and boys reported to be now confined in 1,400 prisons, distributed thruout the United States, were employed in road construction, the number so employed in most of the communities would be but a small proportion of the total labor required, and would be so infinitesimal in its effect on free labor similarly employed as not to be felt.

"Organized labor," freely quoted above, is to be congratulated in the humanitarian attitude it is now generally taking in favor of the employment of convicts on outdoor work, preferably on country roads.

ROAD GRADING *with outfit of four-wheeled scrapers, using Fulton county, Georgia, convict labor.*



EDITORIAL

BUILD NOW.

The evidences of early resumption of activity in all lines are increasing in number every day and it is the duty of the managers of business of all sorts to prepare for the rush which will soon follow the opening of the gates. The present inactivity has thrown many men out of work and the depression has affected the prices of construction materials of nearly all kinds, so that the present is the best time for placing contracts including both labor and materials which this country has seen for many months, and the best which it will see for some years in the future.

Prices and terms are the lowest and best possible, and it is only common business foresight to take advantage of them. Notwithstanding the exceptional reasons for a foreign demand for money, there is plenty of money available, perhaps at a reasonable increase in rate of interest, for legitimate enterprises. It really seems that most corporations have money on hand or readily available for whatever seems to be legitimate expansion. It takes only a little courage to back the conclusion, which must be drawn from a study of the demands of the near future in the light of the present conditions, that within a very few weeks business will open with a vigor which will tax all present facilities and demand more.

Economy demands that advantage be taken of the present low prices of construction materials and labor to make the additions to present buildings, machinery and supplies, so that when the rush does come and neither time nor men are available and prices of materials have begun to soar, the plant will not be swamped and the profits will not be cut off because of lack of room and facilities for handling the business.

Every great war has been accompanied or followed by a great increase in business activity and, so far as the United States is concerned, the effect of the present war is already felt in this direction.

Municipalities in particular should take advantage of the present conditions for the same reasons and for two other reasons, equally good, tho not so lasting. One of them is that the city may give employment to those who are now out of their usual line, and available at lower prices than usual for city work. The other is that, while cities usually do not have the money in hand to pay for work, they can at this time raise money on more advantageous terms than any one else. As already stated, there seems to be plenty of money available for safe investments and just now municipal bonds are the first choice of investors, because they are safe and therefore can be turned into cash with reasonable facility upon occasion and have the additional attraction of a slightly increased rate of interest over that prevailing in the past.

Municipal Engineering can hardly fail to chronicle the adoption of plans for and the beginning of construction of many extensions of present plants and new public and private improvements in the February number, and fully expects its annual spring construction number to be the largest and to show the most extensive prospect of work for the season which it has ever found to record.

HOME RULE FOR CITIES.

An Englishman, William Harbutt Dawson, has recently published a book on "Municipal Life and Government in Germany," which compares the practical home rule of German cities with the carefully supervised governments of English cities to the advantage of the former. It appears that the central government has equal power in the two countries over the detail of the operation of cities, but the German government seldom exercises its control except in matters directly concerning the central government itself or its national political policies, whereas the English government, thru various national boards and thru Parliament itself, interests itself in the smallest details of the administration of its cities and keeps them in such close lines of action that they may almost be said to have no actual powers of their own.

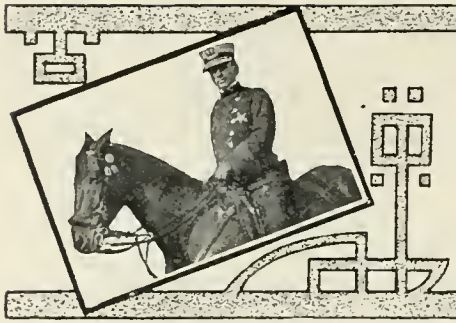
German cities are subject to all the difficulties arising from bi-cameral city councils, entire independence of appropriating and spending authorities, interference of councils with appointments to office, and, on occasion of interference of the state government with all these matters, from which American cities have been trying to free themselves by means of centralization of power in the mayor, the commission form, the city manager, the commission-city manager and their numerous modifications, but by the application of three principles they have been able to develop what is perhaps the most efficient of city management, if judged by results. These three principles are: The separation of municipal elections from partisan politics so that the city council and all officers are selected without control by any political organization; the selection of the administrative officers by a strictly merit system, with the result that municipal office holding is as much a profession as teaching, and officers are selected from any locality within the empire where the most competent and most suitable men can be found; and the practical operation of home rule, which, when properly applied, includes both the other principles.

American cities will do well to study the application of these principles in their own government, as exemplified by the German cities, and may then discover that the true course of improvement in municipal conditions is not so much in the change in form of government as in the full application of these three principles, all of which are recognized by the students of these problems, but none of which have had their full opportunity to demonstrate their value in our own cities.

The annual report of the Director of Public Works of Philadelphia, Morris Llewellyn Cooke, published last summer, is unique in its manner of discussion of the problems of city management and shows many of the lines in which the principles stated can be and should be applied, and reports the measure of success which Philadelphia has attained where it has been permitted to apply them.

Both these publications are well worth the detailed study of those whose hearts are in the search for a solution of our municipal government problems.

January, 1915.



QUESTION DEPARTMENT

Articles on Good Roads

I would like a list of the articles on good roads appearing in MUNICIPAL ENGINEERING during 1914.

P., Washington, D. C.

Following is a list of the principal articles on roads and streets which appeared in MUNICIPAL ENGINEERING during 1914, those on pavements having close relation being included, as street pavements are now required on many main highways.

In vol. xlvi:

January: Paving Methods in Baltimore, p. 2; New York State Highway Specifications, p. 33; Highway Maintenance in Indiana, p. 34; Stone-Gravel Roads Costs, p. 52; Asphalt Pavements in Buffalo, p. 56; Brick Pavements in Buffalo, N. Y., p. 58; Motor Trucks in Street Work, p. 59; The New York State Asphalt Inquiry, p. 67; Creosoted Wood Block Paving in New York, p. 71; Pavements of Rome, N. Y., p. 84.

February: Pavements of Trenton, N. J., p. 102; The Relative Economy of Constructing Bituminous Pavements by Penetration Methods, p. 146; Report on Concrete Roads in Wayne County, Mich.; The Construction of Creosoted Wood Block Pavements, p. 152; Economical Plant for Handling Gravel for Road Building, p. 153; Cutting Down Hauling Costs, p. 165; Asphalt Pavements in New Orleans, p. 177; Trinidad Asphalt Streets in Indianapolis, p. 179; Aztec Asphalt Pavements in Scranton, Pa., p. 182; Permanency Is Keynote in Modern Road Building, p. 184.

March: Motor Dumping Trucks, American and German types, p. 202; Aggregate for Concrete Roads, p. 213; The Maintenance of Concrete Roads: Methods and Cost of Repair, p. 217; Building and Maintaining Roads for the Traffic, p. 234; The Importance of Highway Maintenance, p. 259; Method of Constructing Concrete Pavement, p. 261; Tarred Concrete in Portland, Me., p. 265; Aztec Asphalt in Baltimore Pavements, p. 280; Fifth Avenue Pavement in New York, p. 282; A Portable Plant Laying Asphaltic Concrete Pavement, p. 289.

April: The Municipal Asphalt Paving Plant of Spokane, Wash., p. 304; Bituminous Pavements in Wilmington, Del.; Concrete Alley Pavements, p. 311; Methods of Paving Construction in Baltimore, Md., p. 326; Brick Pavements, Their Maintenance and Repairs, p. 331; Roads to Be Constructed During 1914, p. 348; Road Grading in Counties, p. 352; Sidewalks in County Work, p. 355; Curb and Gutter on County Roads, p. 358; Drains for County Roads, p. 362; County Road Bridges, p. 369; County Road Signs, p. 373; Indiana Spends Fourteen Millions a Year on Roads, p. 384; Old Asphalt Pavements, p. 392; The Tractor for Heavy Hauling, p. 393; Government Supervision of Road Maintenance, p. 394; Revision of Manufacturers' Specifications for Brick Pavements, p. 394; Creosoted Yellow Pine Block Pavements in Dallas, Texas, p. 395; Large Road Contract in Greene County, Tenn., p. 403; Aztec Liquid Asphalt for Oiling Roads, p. 403; Smith Hot Mixer in Annapolis, p. 406.

May: Granite Block Pavements Recut to Small Size and Relaid, p. 426; Bituminous Road Construction, a Report of English Experience, p. 440; Laying Wood Paving in London, p. 446; Melting Point Tests of Bituminous Materials, p. 471; Concrete Road Construction in Indiana, p. 472; The Principles of Scientific Management as Applied to Highway Engineering, p. 474; Permanent Road Construction in the United States, p. 476; Prison Labor on Roads, p. 477; Motor Truck Service and the Puhlic Roads, p. 485; Trinidad Asphalt for Maple Road, Indianapolis, p. 489; Aztec Asphalt, p. 492; Creosoted Wood Block Paving in Jersey City, p. 492; The M-C Paving Mixer, p. 494.

June: Reinforced Concrete Trestle in California Highway, p. 517; German Motor Trucks and Trailers, p. 528; Concrete Roads in Illinois, p. 534; Progress of the Asphalt Industry, p. 563; Modern Bituminous Surfaces and iBtuminous Pavements, p. 566; Good Roads a Factor in Real Estate Values, p. 569; Concrete Paving for Buhl, Minn., p. 569; Road Bee Day in Michigan, p. 574; Tractors on State Roads, p. 574; Asphalt Plant in Use on Road

Work at the Ashokan Reservoir, p. 576; Loss of Time in Unloading Gravel, etc., Eliminated, p. 577; Some Modern Developments in the Asphalt Industry, p. 579; A Tractor with a Heavy Load, p. 580; Joint Protector for Concrete Pavements, p. 581.

In vol. xlvii:

July: The Bitulithic Pavement, p. 2; Who Supplies Novaculite, p. 47; Voids in Crushed Stone, p. 47; Burned Asphalt Cement Can Be Prevented, p. 49; Buckling of New Brick Pavement at Elmira, N. Y., p. 50; Empirical Requirements in Asphalt Specifications, p. 51; Variations from the Standard Asphalt Specifications, p. 53; Slab Tests of Brick Pavements, p. 54; Bituminous Concrete in the Roland Park, Guilford District, p. 56; Concrete Roads and Streets in the United States, p. 61; Better Roads Cut Living Cost, p. 62; Efficiency in Road Building Equipment, p. 69; Montreal's Portable Asphalt Paving Plant, p. 73; The South's Good Roads, p. 74; Hot Penetration Road Oiler, p. 75; Semi-Portable Bituminous Mixing Plant, p. 76; Condition of New Jersey Roads, p. 80.

August: Bitulithic on Macadam on Marlboro Street, Boston, Mass., p. 90; Good Roads as Crop Producers, p. 109; Economic Side of Good Roads Days, p. 120; Burned Asphalt Can Be Prevented, p. 125; The Perfection of the Modern Street Pavement, p. 148; Evolution of a Business Street, p. 150; The Cost of Good Roads, p. 151; A Ribbed Arch Highway Bridge, p. 152; Objects of the Indiana State Highway Commission, p. 153; The Passing of the Road Boss, p. 155; Re-inforced Concrete Street Paving, p. 165.

September: The Municipal Asphalt Plant of Chicago, Ill., p. 184; Pavement Economy, p. 190; Expansion Joint in Alley, p. 214; Burned Asphalt Quite Unnecessary, p. 216; Buckling of New Brick Pavement at Elmira, N. Y., p. 221; Relation of Traffic and Cost of Maintenance of Roads, p. 225; An Unsupported Brick Highway in Continuous Use, p. 227; Asphalt Repairs in St. Paul, Minn., p. 229; European Rock Asphalts, p. 230; Fibered Asphalt Pavements, p. 234; Using the Motor Truck, p. 249.

October: Methods of Unloading Tank Cars, p. 256; Portable Asphalt Plant Resurfacing Macadam Road in Chicago, p. 263; Topeka Specification Asphaltic Concrete, p. 292; Burned Asphalt Cement Can Be Prevented, p. 294; Putting Paving on a Systematic Basis in New Orleans, p. 297; Repairing Concrete Pavements, p. 297; Laying Concrete Pavement, p. 298; Slag for Road Paving, p. 300; Calcium Chloride in Road Maintenance; Removal of Wood Block Troubles in Europe, p. 303; Street Paving in Des Moines, Iowa, p. 304; Division of Roads for Traffic, p. 305; Recent Granite Block Pavements in Philadelphia, p. 306; Increase in Use of Concrete Pavements, p. 308; Guide Post in England, p. 308; A Brick Road as a Monument; Good Roads Movement in Northern Illinois; Lighting the Lincoln Highway, p. 321; The Buffalo Brick Convention, p. 322; Bermudez Road Asphalt.

November: Recut Granite Block Paving in Bronx Boro, New York City, p. 344; Gas Leaks Under Bituminous Pavements, p. 351; Vitrified Brick Street Construction, p. 364; City and County Highway Drainage, p. 371; Motor Trucks for Market Delivery, p. 391; Repairs to Concrete Pavements, p. 393; Paving with Small Granite Blocks, p. 393; Cost of Supervision of Highway Construction, p. 395; The Filler for Brick Pavements, p. 399; Improvements in American Paving Practice Suggested by European Experience, p. 400; A Refrigerator Motor Truck for Dairy Products, p. 412; Wire-Cut-Lug Brick Has Phenomenal Popularity, p. 412.

December: Bituminous Macadam Roads in Rhode Island, p. 430; Motor Truck for Oiling Roadways, p. 442; Concrete Streets on Steep Grades in Mankato, Minn., p. 451; Rochester Can Specify Biutlithic, p. 455; New Municipal Asphalt Plant at Pittsburgh, Pa., p. 460; Increase in Asphalt Production, p. 463; Asphaltic Materials for Road Consrtuction, p. 464; Recut Granite Block Pavements, p. 467; Reinforced Concrete Pavement Foundation Over Trench, p. 471; The Development of the Road Paving Plant, p. 479; Clark's Traction Grader, p. 481; Street Signs and Sign Posts, p. 482; Steam Melting Asphalt Plant, p. 484.

Laying Vertical Fiber Brick Pavement

We have up for consideration now before our city officials a proposition of paving a street 30 feet wide, 3,900 feet long, with vertical fiber paving brick blocks. These are to be laid on old macadam base. At present the street has 9-inch crown but is very irregular. Curbs are in good condition.

I have never had any experience with this kind of paving material, and if consistent would like to have your opinion on the following questions:

Will vertical fiber vitrified brick blocks stand 18 per cent. test on 1911 rattler with 300 pounds cast iron foundry shot 1,800 revolutions per hour for one hour?

Just how should asphalt be flushed on and how much asphalt per square yard should be used where paving is laid on 1½-inch sand cushion?

Could above described street carry more than 6-inch crown to be 2 inches higher than curb and give satisfactory service and be consistent with good workmanship?

J., ———, Mo.

There is no reason why the vertical fiber paving blocks should not stand the same rattler test as blocks made from the same material in the ordinary form.

The question is therefore one of the particular make of brick, as to material, method of manufacture, manner of burning, etc., and brick of either fashion may be subjected to the same tests and accepted or rejected under the same specifications.

The usual method of applying asphalt filler is to pour it hot into the joints from a can thru a spout so as to spread as little of the asphalt on the surface as possible. The amount of asphalt or other filler used will depend on the design of the lugs on the blocks and the closeness with which the bricks are laid to each other. One gallon per square yard is a rough estimate of the amount required.

The tendency with the modern kinds of traffic is toward flatter crowns so that the traffic will distribute itself better over the whole width of the pavement. A 9-inch crown causes the traffic to keep on the center line as much as possible. Perhaps the crown can be reduced somewhat if care is taken, in taking the inequalities out of the surface of the old macadam, to cut down such projections as appear in the crown of the old roadbed and fill such inequalities as appear near the gutter. The old macadam may be enough thicker in the center to permit cutting it off an inch or two, which may be all that is actually necessary to bring the crown down to 6 inches. Perhaps the gutters can be filled a little. However, the new surface of the street will be raised by 4½ inches, the thickness of brick and sand cushion, and it may be difficult to take care of the drainage with any more fill in the gutter. The difficulty in laying a brick surface on an old macadam base usually occurs at this point.

If the street is very nearly level, the crown may be 6 inches or even a little more for a 30-foot street, tho it would be better if less, but if it has a considerable slope longitudinally the crown should be still less.

Ordinances Regulating Street Excavations

I will appreciate it very much if you will send me copies of latest approved ordinances regulating excavations and improvements made by gas companies in public streets and thorofares. I desire in particular, if possible to procure the same, an ordinance where the gas company is required to deposit a forfeit and the city does the work at the expense of the company.

S., ———, Tenn.

The writer does not know of any city in which the city makes excavations for laying or repairing gas pipes or connections and replaces pavements at the expense of the gas company. A few cities having municipal street repair plants relay the street surface at the expense of the company. Can any of our readers cite ordinance or contract such as our correspondent desires?

Such regulations regarding connections made for plumbers with municipal pipe systems, whether water, gas or sewer, are in operation, but very few cities go farther than to require a plumber wishing to make such connections to make a deposit or file a bond to cover any expense which the city may incur in correcting his errors in making such connections and replacing pavements.

In MUNICIPAL ENGINEERING, vol. xlii, p. 185, will be found a rather new franchise for a gas company, which contains about the only form of requirement usually made, this one to the effect that "if said changes are not promptly made within a reasonable time after such notice, the city hereby reserves unto itself the right to remove all such conduits, appurtenances and apparatus from such streets, alleys or public grounds and collect the cost and expense thereof from said company. And if said company shall not promptly pay such costs or expenses on demand, the same shall be taken and held by the parties to be grounds for the revocation of the rights and privileges of said company on the streets, alleys and public grounds affected."

Specifications for Park Road

I would like specifications for a park road, 16 to 18 feet wide.

F. M. S., Peru, Ind.

Specifications have just been issued by the American Society of Municipal Improvements for gravel and macadam roads which are proper for park driveways. Waterbound macadam with or without bituminous surface treatment afterward and bituminous macadam by the penetration method are covered by these specifications, and choice should be made among them according to the amount of traffic the restrictions put on the kinds of traffic that may pass over the road and the money available for the work.

Six sets of specifications which have been adopted by the society, those for asphalt, brick, concrete, macadam and gravel, and stone block pavement, and sewer construction and one, wooden block pavement, which has not been adopted, are now ready for distribution at 25 cents each, and will be followed later by an eighth, bituminous macadam, not yet adopted by the society. These specifications can be obtained from the secretary of the society, Charles Carroll Brown, 702 Wulsin Building, Indianapolis, Ind.

WORKERS IN THE FIELD

Houston, Texas, Has Co-operative Lighting Franchise

The Editor of MUNICIPAL ENGINEERING:

Sir—For years the Houston Lighting & Power Company, without competition, had been showing net earnings of about 20 per cent. on the successive yearly valuations. Total dividends of the company on the stock from 1906 to 1914 were $1,553,125.00, and the net value of the properties of the company on the last year was only $1,524,841.79. The service was fair to the consumer but the rates were admitted to be rather high.

In February, 1914, Mayor Ben Campbell, of the city of Houston (which is operated under the commission form of government), inaugurated the first step of an investigation into the affairs of the Houston Lighting & Power Company, with the avowed purpose of either bringing about a substantial and equitable reduction in the price of electric light and power for the people of Houston or building a municipal lighting plant for Houston. To this end, the city of Houston secured the services of Mr. Lamar Lyndon, consulting engineer, of New York City, who, assisted by a corps of experts, made a minute examination of both the physical and book properties of the lighting company, operating statistics, earnings and disbursements and the general output and equipment of the company. His comprehensive report, together with his recommendations for making the new rates, was submitted to the city of Houston. A copy was furnished the lighting company, who immediately employed an expert to go over the report and submit a counter-report. The difference in the valuation put on the properties of the company by the city's expert and the company's expert was aproximately $1,000,000 due largely to the fact that the company had taken no account of depreciation during the life of their plant. A fund was provided for depreciation by the company at one time, but subsequently passed to dividends.

The result of these reports was: (1) To present a financial history of the company; (2) To determine the proper valuation of the properties of the company, which should be used as a basis to determine the income which the company should receive in order to make a reasonable profit on its investment; (3) To show what the company received from all classes of service up to January 1, 1914, in order to pay all costs, depreciations and 8 per cent. profit on the proper capital charges existing over the period of years considered; (4) To show the various rates for electrical service which should obtain in Houston under the conditions of load, load factor, distribution and investment as obtain with the present equipment of the company, and compare them with the actual rates, and (5) To recommend equitable, just and fair rates for the future.

Pending the settlement of the lighting question, the city of Houston passed an ordinance which stated that any adjustment made between the company and the city of Houston, must apply and date from and after April 1, 1914, consequently, the rates just named will mean a substantial cash discount or refund to the citizens of Houston dated back from April 1, 1914.

During the progress of the light controversy, Mayor Campbell investigated every contract held by the company for power or light with wholesale customers. This inquiry resulted in ascertaining that thirty-two wholesale customers in the city of Houston were under "special contracts" with the company, by which contracts they received light and power at prices from 5 to 2½ cents per Kw. hr., while the other citizens were paying prices from 13 to 7 cents per Kw. hr. The company explained that they were "compelled" to make special contracts to prevent the wholesale customers from constructing their private generating plants.

After eight months' investigation, the following comprise the new light rates,

which will save the citizens of Houston, Tex., approximately $200,000 each year, and explain their workings:

Lighting Rates: Nine cents primary per Kw. hr., and 5 cents per Kw. hr. for secondary consumption. All charges for lighting consumed for residential purposes each month shall be divided on the bill into primary and secondary charges, and the methods of determining primary and secondary energy shall be as follows: The unit for measuring the amount of energy to be charged for on primary basis shall be one-fortieth of the number of socket openings to each residence served, and the number of kilowatt hours charged for primary service shall be 30 times the unit thus attained; or, in other words, the primary basis shall be, as to each residence, the first 30 hours use in any monthly period of 50 per cent. of the connected load, the connected load being taken at 50 watts per socket opening in the premises served. All energy used by each residence in one month in excess of the energy thus charged as primary, shall be charged to the customer as secondary consumption at secondary rate. This formula shall be printed on the back of every bill rendered Houston customers.

Commercial Rates: To be the same as above, except as follows: The first 40 hours' use in any monthly period of the connected load of 50 watts per permanent socket opening in the premises served.

Power Rates: There shall be charged not more than the following rates: Five cents per Kw. hr. for primary and 2½ cents per Kw. hr. for secondary consumption. All energy for power service shall be divided into a primary and a secondary charge, and the energy that shall be paid for on primary rate shall be the number of kilowatt hours consumed which would be equal to 17 times the rated horsepower of the motors connected in the business served, and all energy consumed each month in excess of the energy charged as primary, shall be charged for at the secondary rate as secondary consumption. This formula shall also be printed on the back of every bill, for the benefit of the customer. In addition to the rates for motor services, the company is permitted to charge 25 cents per month per horsepower of connected load, based on the motor rating. Where extra motors are installed for fire protection only, the company is permitted to charge 25 cents per horsepower per month, based on the motor rating; and where they are installed in "readiness to serve" in emergency cases, such as breakdowns, etc., the company is permitted to charge 50 cents per horsepower per month, based on the motor rating.

Arc Lights: All series circuit outdoor city arc lights shall be installed complete for $57.50 connected with an overhead circuit; and $60 each when connected with underground circuit, per year, payable in monthly installments. These arc lights shall utilize not less than 6.6 amperes at approximately 80 volts per lamp. Where alternating arc lamps are used, the actual energy consumption in any lamp circuit must not be less than 425 watts per lamp, while in the case of magnetite lamps, the energy consumption must not be less than 350 watts per lamp. The company is required to use German "Electra" carbons or other carbons of equal merit in all alternating arc lights, and cored carbon in all lamps, and the light shall at all times be uniform and free from flickering, hissing or pumping.

Cooking Rates: Minimum bill, 50 cents per month. Energy for cooking to be metered separately at the rates of 5 cents for primary and 2½ cents for secondary. The unit of measuring the primary current shall be determined by the first six Kw. hr. of consumption each month for cooking and the balance of the energy consumed as secondary consumption.

Electric Fans: Where the entire load on the circuit is made up of fans, this load shall be rated as a motor load and shall take the same rates as for power service.

Representation on Directorate: The mayor of the city of Houston, under the light adjustment, was given the power to name two members of the board of directors of the Houston Lighting & Power Company, which members will own no stock, but will represent the city's interests on said directorate.

The Houston Lighting & Power Company is owned by the American Cities Company which, in turn, is controlled by the United Gas & Electric Company of New York, according to the findings of the investigators. That a settlement of so much importance also gave the city of Houston the right to participate equally in all earnings of the company above $160,000, or 8 per cent. on their valuation, at the end of the first year, was one feature which pleased the people of Houston. The city claims that the new rates will permit the company to make more than 8 per cent. on their property valuation. In a year the city of Houston will be entitled to one-half of all earnings over $160,000, and will still have the privilege of reducing the light rates to the people so that there will not be an excess in the earnings over 8 per cent. on the amount involved.

Under the rates just made Houston has the lowest lighting and power rates in the South furnished by a private corporation.

PAUL H. SHELDON,
Houston, Tex.

Following are given the old and new rates in tabular form, so that comparison can be made readily:

OLD RATES

COMMERCIAL

Primary, per Kw. hr.....$0.13
Secondary, per Kw. hr..... .07
Subject to 5 per cent. discount.

POWER

Primary, per Kw. hr.....$0.06
Secondary, per Kw. hr..... .05

ARC LIGHTS

City, per year.....$70.00
Commercial per year..... 90.00

NEW RATES

COMMERCIAL

Primary, per Kw. hr.....$0.09
Secondary, per Kw. hr..... .05
Subject to 10 per cent. discount.

POWER

Primary, per Kw. hr.....$0.05
Secondary, per Kw. hr..... .02½

ARC LIGHTS

City, for Underground connections.$60.00
City, for Overhead services..... 57.50
Commercial—The same as above.

Sewer Tunnel Construction in Alton, Ill.

The Editor of MUNICIPAL ENGINEERING:

Sir—A sanitary sewer district of 13½ miles of main sewer consisting of 8, 10, 12, 15 and 16-inch pipe and 4½ miles of 6-inch lateral connections built by Chas. E. VanWormer, of Springfield, Ill., contractor, has been completed and accepted by the Board of Local Improvements of Alton, Ill., and is now in successful operation.

In the construction of the system it was necessary to construct an outlet sewer two miles in length to the Mississippi River about 1,000 feet of which is in tunnel thru a hill 39 feet high, in which 12-inch cast iron pipe was laid at proper grade. The contractor in the construction of this tunnel deemed it a small job in itself and thought it not advisable to provide an expensive equipment for the construction of same. Such difficulties as arose during the construction had to be met with a rough equipment on hand.

The stakes were set every 50 feet on the center line and every 200 feet shafts were sunk to the proper grade. These shafts were made 4 by 8 feet and properly braced with oak timbers. The 8-foot side was parallel to the center line of the sewer. At each side of the shafts plumb-bobs were dropped and used to line up the tunnel driving.

Two shafts were worked at a time. Over each shaft was placed a swinging boom from which a wooden bucket was lowered and raised in the shaft with wire rope. Midway between the shafts an ordinary double-drum hoisting engine was placed. The wire rope from the buckets wound on these drums so that when one bucket was up the other bucket was down in the shaft. At the bottom of the shafts the heading was driven in both sides at the same time. The tunnel was made 6 feet high and 3 feet wide. The sides and top were sheated with 3-inch oak planking as the tunnel was driven. One man was at the heading, one man loaded the wheelbarrow and wheeled the muck to the shaft, where it was dumped into the buckets and raised to the surface and dumped. When a tunnel had been driven halfway to the next shaft, work from that end stopped, and the men went ahead to the next shaft. The heading men usually met very close to the center.

One difficulty experienced, was lack of ventilation. It was impossible to keep a light burning in the tunnel so that men could see or breathe after they had gone a few feet from the shaft. To overcome this an ordinary blower fan was secured and a 1½-h.p. gasoline engine was used to operate same. From the discharge end over the blower fan a 3-inch galvanized iron down-spouting was connected by means of tees, elbows and straight pipe down into the two shafts and thence each way into the headings. This fan furnished sufficient air so that all four headings could be worked continuously.

The booms above the shafts were also used for lowering the 12-inch cast-iron pipe. The pipes were lowered at the lower shaft and pulled ahead by cable tied to hoisting engine. When all the pipe had been lowered to extend from one shaft to the other and pipes were lined up and set to proper grade, spigot ends were driven home into the bell ends and yarned and calked with lead. The entire equipment was then moved to the next shaft, and the same process as above described was gone thru.

The entire 1,000 feet was driven in this way. Three shifts were steadily employed, each working 8 hours. The total cost of the improvement was $97,000.

The tunnel was driven and pipe laid in eight weeks. The work was carried on under the supervision of the writer as city engineer.

J. E. SCHWAAB,
City Engineer, Alton, Ill.

The Training of the City Manager

The more efficient the government, the more efficient the employe.

Mr. Bryce, of the American Commonwealth, says: "There is no denying that the government of cities is the one conspicuous failure of the United States."

This statement should not be too discouraging. For years we ourselves have recognized the fact that we have been improving the conditions steadily.

In 1876 New York appointed a commission to devise a plan for the government of cities in the State of New York, and they suggested the following as the causes of the failure of the old forms of municipal government:

1. Incompetent and unfaithful boards and officers.
2. The introduction of state and national politics into municipal affairs.
3. The assumption by the legislature of the direct control of local affairs.

Sometime ago we began to realize that the city was a business corporation rather than an integral part of the state. In 1882, Brooklyn, New York, took a step toward concentrated power in connection with concentrated responsibility, by giving the mayor absolute appointive power without the confirmation of council of the principal executive heads of the departments.

Mr. Woodruff epigramatically states, "For policy we must select, for efficiency we must appoint."

This has been the difficult step to achieve: it means the breaking of the political hold on our political affairs, the loosening of the grasp of the professional politician, who stands for efficiency in his ward and precinct organization first, and efficiency in municipal affairs second. As Mr. Bryce so aptly states in criticising our municipal affairs, "There is a want of methods for fixing public responsibility on the governing persons and bodies."

We know from experience that the political appointee's first allegiance is to his political machine. This tradition has shackled general advance.

The city manager form of government is the application of business methods to the operation of a city.

The fundamental training of a city manager is the same as the training of any manager of large affairs.

He does not have to be an engineer.

In many American cities the engineering problems are the most important today.

Any good executive can be a good city manager.

Cities desiring city managers should elect the one whose previous training will best meet the requirements of every community.

If these statements are true, and we believe they are, how can city managers be best rtained?

A city manager should have at least a fair education, sufficient theory, but not too much to overbalance practicality.

He must be an executive.

He must know how to handle men.

He must be fair and just.

He must be firm but polite.

He must have the courage of his convictions.

Any man with these qualifications can be a city manager. Such a can can select subordinates and advisors to aid him in carrying out the functions of those departments with which he is not familiar in detail.

He as an executive must get efficiency from all his departments by organization.

This is what we have always attempted to accomplish in our old forms of municipal government.

We found, however, that we could not select them thru the ballot.

This is where the straight commission form of government is failing, as it attempts to select trained men for principal functions thru the hallot, and also attempts to combine the legislative and the administrative functions.

There is in communities a feeling against the employment of out-of-town men for city managers. This is usually the harping of the old faithful in the ranks of the political parties.

A perfect organization can usually be attained more quickly by selecting a manager from out of town, as he is not hampered by the local traditions.

I cannot lay too much stress on the importance of publicity. Under the old forms of government only such publicity was given as would best meet the ends of the particular parties in power.

The new forms of government must give to the citizens constructive publicity.

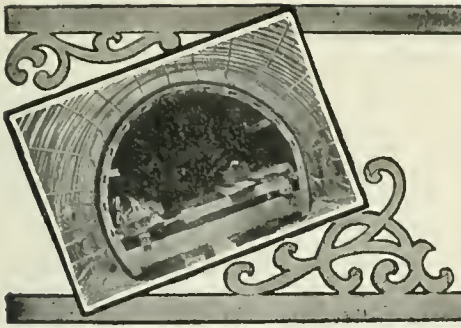
We must educate the people to the advantages which they are receiving from the new form of efficient government.

Under the old order of things, as soon as one party was elected into power, the public were immediately put thru a course of education as to why that party should be out of power.

The result has been that the notion is inbred for change.

As a result, every two years the citizenship becomes restless for change. This can only be overcome by education and constructive publicity.

H. M. Waite,
City Manager, Dayton, O.



SANITATION

Pollution of the Des Plaines River by Chicago Suburbs

The Des Plaines river rises in Wisconsin a few miles north of the Illinois line and runs south parallel to the shore of Lake Michigan until it reaches the present location of the Chicago drainage canal when it turns toward the southwest and makes its way to the Illinois river. Above the drainage canal it receives very little drainage from the city of Chicago proper, but its watershed contained a population of 71,960 in 1910, of which one-third were inside the sanitary district. At present there are some eighteen or twenty sewers and drains of 15 to 18 inches diameter discharging into the stream and there is one sewage disposal plant in operation, that at LaGrange, a population of over 47,000 being served at least in part by these sewers. The central villages contain about 25,000 of this population, which would require a flow, for proper dilution of the sewage, of 85 cubic feet per second. This flow is attained on the average not much more than half the time and there may be 225 days in the year when the flow in this part of the Des Plaines river is less than 10 cubic feet a second. It is evident, therefore, that complaints of nuisance are well founded and will become more serious as the population increases.

A report by the engineers of the sanitary district shows that the flow of the river cannot be equalized to produce a satisfactory low water flow by means of reservoirs or otherwise and that pumping water from Lake Michigan for dilution would be too expensive.

Outfall sewers and sewage treatment plants are compared for each village and for the villages together and various plans are presented, contrasted and compared.

The problem is further complicated by the suit to prevent the use of more Lake Michigan water for diluting Chicago sewage in the drainage canal. If this suit is successful, all the sewage of the territory on the Des Plaines above the canal must be purified before it is discharged into the river. If it is not, at least part of the sewage can be brought down by intercepting sewers and discharged into the canal without treatment.

Meantime the report recommends the preparation of such plans as may be prepared in advance of the decision so that there will be no loss of time in beginning construction when the field is clear. The population of the area is requested to bear the ills it has with the best grace it can until the decision is made, as otherwise its expenditures may be on works which must afterwards be abandoned or changed at great unnecessary cost.

Sewer Explosion at East Boston Pumping Station

Associate Justice Charles J. Brown, of the East Boston District Court, has filed his report on the inquest on the explosion June 1 last at the pumping station of the Metropolitan Sewerage plant in East Boston with the clerk of the Superior Criminal Court.

The explosion resulted in the death of James Grourk, Philip Healey, Martin Devereaux, Cornelius Sullivan, Thomas M. Butler and Elmer Gifford, while others were injured. The inquest was conducted during Jnly, and postponed until October, pending an investigation of conditions by experts.

Judge Brown's report on the death of James Grourk, which is similar to that of the others, is as follows:

"James Grourk died in consequence of burns and injuries received by him caused by an explosion of gasoline in the Metropolitan sewer at the pumping station located at Chelsea Creek, in East Boston. This pumping station is one of the largest in the Metropolitan system, and pumps the sewage which comes from all the cities and towns of the north Metropolitan line.

"On the day of the accident the deceased, with other employes, was working in what is called the screen room at said station, installing a duplicate set of screens. There was a large amount of gasoline in the sewer, which vaporized and was ignited from some source unknown, causing a terrific explosion, which demolished the building and injured several people, of whom six died.

"This branch of the Metropolitan sewer covers a distance of 62½ miles, and has the sewage of many cities and towns flowing into it. There is a large number of garages in these cities and towns, which have connections with this sewer, as well as several de-greasing plants, laundries and other manufacturing establishments, which are constantly discharging gasoline, naphtha and benzine into this sewer, making it extremely dangerous and a menace to the public safety.

"I find there is a general laxity on the part of the local authorities in preventing this, and I recommend that the Metropolitan Water and Sewerage Board or the district police take the necessary action to remedy this evil.

"A most thoro investigation and examination by city and state engineers of the sewer and pumping station at different periods, as well as analyses made by city and state chemists of the effluent and air, proved conclusively that gasoline and other explosive substances are continually flowing thru the sewer, and I further recommend that all garages and other establishments using gasoline, naphtha and benzine in the several cities and towns which have connection into this sewer be compelled to instal separating traps, as is required under the regulations of the city of Boston.

"If this is done it will prevent almost entirely any gasoline, naphtha or other explosive substance getting into the sewer in the future."

The Metropolitan system that empties at East Boston is 62 miles long, and is the outlet for Arlington, Belmont, Charlestown, Cambridge, Chelsea, East Boston, Everett, Malden, Medford, Revere, Somerville, Stoneham, Wakefield, Winchester and Woburn.

Street Cleaning in New York

The department of street cleaning of New York city had an appropriation in 1913 of $8,403,205. This was to pay the expense of cleaning streets, removing ashes, rubbish, street sweepings and garbage to the dumping places, the removal of snow and ice and the sanding of the streets.

The city is divided into districts and each district into sections. In a paper by Frederick L. Stearns before the municipal engineers of the city of New York, the ninth district is taken as typical. This district is bounded by 58th and 89th streets, Central Park and the Hudson river, in charge of a district superintendent with a conveyance, and has four sections, each with section foreman with bicycle and an assistant foreman.

The district has 624,864 square yards of pavement and the daily average cost of cleaning the district is $238.52. The average number of sweepers is 64, each cleaning 9,654 square yards. The cost of hand sweeping is 38 cents per 1,000 square yards; $3.07 per cubic yard of sweepings. The average number of drivers used in the district is 60.

Hand Sweeping. The street sweeper, with his outfit, consisting of a can carrier, push cart, push broom, push scraper, etc., is assigned to a route. He goes over his route in the morning, picking up the litter, then goes over same, sweeping it. He puts the sweepings in a can on his can-carrier. When the can is full, he places it on the sidewalk near the curb. The cart driver collects these sweepings and takes them to the dump.

During the winter months, the sweeper wears a coat and cap, and thru the summer months a shirt with D. S. C. on it and a white helmet.

The sweepers meet at their respective section stations for roll call at 7.:45 a. m. and after 4 p. m. of each week day. In these section stations each sweeper has a locker for his clothes, etc., and there are storage rooms for the utensils. Previous to Col. Waring's time the sweepers met on the street corners and stored their brooms and shovels in such basements as they could get permission from the owner. The sweepers receive $780 a year and 25 cents an hour for Sunday work. There are 2,570 regular sweepers and 349 extra sweepers.

In the whole city the area of pavement to be cleaned is about 26,454,500 square yards. The average area for a sweeper to clean is 8,895 square yards.

Sweeping Machines. Revolving brooms sweep the street dirt into the gutter. By hand labor it is piled and shoveled into carts or put into cans by the street sweepers on the route. Nearly all of the 148 sweeping machines now in use were built by contract from plans and specifications prepared by Mr. Stearns.

The machines average in cost $185 each. New parts are kept in stock and the repairs are made by the department force.

The broom itself is made of thin hickory strips and does not revolve unless a clutch is thrown by the driver connecting the broom axle with the traction

wheels. The sweeping machines are used where the sweeping is heaviest and are a great help to the hand-sweeping force. These machines cannot be used unless the street is first sprinkled to lay the dust. As the use of water is prohibited during the winter months, the machaines cannot be used during this part of the year. It costs 52 cents per 1,000 square yards to clean strets by this method.

The Merritt sweeping machine has three revolving brooms, one on each side of the machine, set at an angle so as to sweep the street dirt under the machine, and another set straight across at the rear which sweeps this dirt on to a conveyor. This dirt is conveyed to the top of the machine and discharged into cans on a platform in the front of the machine. These cans when full are placed upon the sidewalk near the curb and replaced by empty cans. The driver on the route empties these cans as he comes along making other collections. The city paid 41 cents per 1,000 square yards for the work done by this machine.

The Emerson vacuum cleaner has a broom that does the sweeping, a conveyor that carries the street dirt to a receptacle and a revolving fan that produces a current of air that carries the dust thru screens like the pneumatic carpet cleaner. The city paid 43 cents per 1,000 square yards for the work done by this machine.

Flushing. The most thoro method of cleaning streets is by the use of water in dry weather. The water washes the dust from the street surface and in moist weather it washes the slime away.

There are several methods in use for this purpose, the most common of which is washing the street with a hose attached to a hydrant. It is, however, expensive, wasteful of water and obstructs traffic. In a gang there are several sweepers with push brooms that sweep up and put in their can any material not washed into sewers. Hose flushing in the summer days is very welcome in the tenement district.

The cost of hose flushing per 1,000 square yards is 65 cents and requires an average of 1,969 gallons of water.

Another method of cleaning the street is by the use of flushing machines. There are two styles of such machines in use. In one there is an air and water tight tank. As the water enters the tank from the hydrant, it compresses the air in the tank, which is generally at about 5-lb. pressure before it is charged with water, until it is at the same pressure as the water in the hydrant. This compressed air forces the water on to the streets thru properly arranged nozzles. This arrangement is quite slow. Officials of the city came to watch these machines in operation and became impatient because most of the time the machine was either going to, coming from the hydrant or at the hydrant getting its charge of water. It has been found to be very saving in the quantity of water used and by going over the surface of the street a sufficient number of times, thoroly cleans any kind of pavement. Its slowness of work is, however, offset by its cheapness of operation. The pressure that forces the water onto the street is obtained from the pressure of the water supply, and any driver of ordinary intelligence can run the machine. It costs 39 cents to clean 1,000 square yards and uses 401 gallons of water. The city has tried several experimental machines of this type but at present owns only one.

Mr. Stearns designed a machine that had an air tank in one end of the large tank. There was a gasoline motor and air compressor on the front of the wagon. The air compressor was small and ran all the time, filling the air tank with compressed air. This compressed air was to be used as the pressure obtained from this hydrant became too low for effective work, thus keeping up the pressure until it was nearly all out of the tank. The valve to the air tank was then closed and the air compressor continued running all the time the machine was driving to the hydrant, charging, returning to the street to be flushed and until it was time to open the valve to connect the two cells of the tank. Air compressors are very heavy and this arrangement made a lighter machine and made use of all the pressure that could be obtained from the hydrant pressure and only acted as an auxiliary pressure supply.

Another machine was designed to work independent of the hydrant pressure. The tank was completely filled at the hydrant. The air compressor was large enough to pump all the air that was necessary to force the water to the street, as this required pressure. It was the most powerful and rapid apparatus that has ever been tried for street cleaning. In working for hours it only required three and one-half minutes to a block; this included all the time required for charging with water and traveling to and from the hydrant. This is some contrast to the previous machines that required 22½ minutes to a block. These blocks were running north and south on Madison avenue.

The other style consists of a water tank, gasoline engine, and a water pump. The tank is completely filled with water like an ordinary sprinkling wagon and the rotary pump forces the water onto the pavement at any desired pressure.

It is easier to pump water than air to do the same amount of work, and the machinery is much lighter.

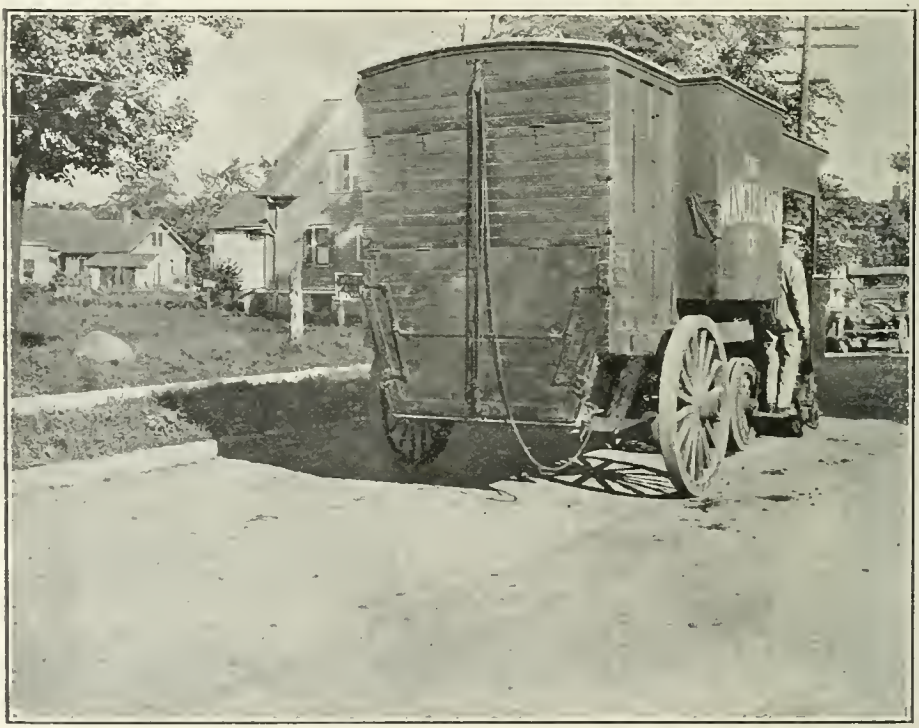
This machine works faster than the hydrant pressure machine, but a higher priced operator must be employed to run the engine. The cost of repairs are also higher and the cost of the gasoline must be added to the costs of operation. It is not dependent on the pressure of the water supply and is very satisfactory. Four of these machines are owned by the city.

Another method of washing the street is by the use of a squeegee machine. There is on this machine a water tank that sprinkles the pavement under the front wheels and a revolving rubber squeegee at the rear of the wagon. This is also quite a satisfactory machine for asphalt pavement that is in good condition. It is also very economical in the use of water and the revolving rubber squeegees the mud, dust and slime to the gutter, where it is picked up by the street sweepers. The city owns thirteen of these machines.

Experiments have been made with river water for flushing purposes, but there is a strong sentiment against its use because of its pollution with sewage.

By instruction of the former Commissioner Woodbury, Mr. Stearns exposed gelatine plates in different parts of the city and collected dust, particles and germs from the air before and after washing the street. It was found that the washing greatly reduced the germs. In one experiment the reduction was from 239 to 85 colonies. These plates were placed in an incubator at the Cornell Medical School,, and the germs allowed to grow until in the best conditions for photographing and examining under the microscope.

SHOWING *work done by a pneumatic broom sweeping machine on brick pavement.*



ROADS AND PAVEMENTS

Road Economics

The following selections have been made from the excellent paper before the Atlanta Road Congress by J. E. Pennybacker, chief of road economics of the U. S. Office of Public Roads:

1. All who share in the benefits of road improvement should share proportionately in the burdens.

The country road is no longer a mere local utility. Legislation should, therefore, provide for city taxation in aid of country road improvement. Automobile owners should individually pay a material portion of the cost of our public roads.

2. The degree of improvement should be proportionate to the traffic important to the road improved.

Too often have we seen costly improvements distributed according to the dictates of a few influential citizens or according to some arbitrary arrangement of politlcal units or for sentimental reasons, or thru a cheerful, haphazard indifference. It is now generally believed that four-fifths of the traffic of this country is carried on one-fifth of the road mileage. It should be manifest that the most heavily traveled roads should first receive attention and should be improved in the most substantial manner. It is entirely feasible to make an expert study of a country road system and indicate graphically the traffic areas for each important road, so as to establish with reasonable exactness the amount of outlay which the traffic would justify.

3. The rate of payment or the rate of accumulation of the sinking fund on any public debt contracted for road improvement.

One faction either opposes debt in any degree, or contends for an indebtedness of such short term as to make it almost a cash transaction, and asserts that the road is entirely destroyed long before the debt becomes due. Another extreme faction contends for long-term indebtedness, on the theory that as posterity will reap the benefits it should bear the burdens, and that a road well maintained never wears out. As a matter of fact, location, if intelligently made, should be permanent; likewise all reduction of grades. The drainage features, if honestly and efficiently constructed, should be reasonably permanent. The road, except under extraordinary conditions, should, therefore, be considered reasonably permanent as to these features. As a general rule, the foundation of a road should not require renewal if the road is subjected to adequate and continuous maintenance. Avoiding any detailed consideration of the exact proportion of the total cost of a road represented by these features, I should say that in general the permanent features would average at least 50 per cent. of the total cost. So that, if the other 50 per cent. must be figured as perishable and subject to renewal, the debt should not cover a period longer than twice the length of this perishable portion.

4. Road building and maintenance comprise work requiring special qualifications on the part of those who direct it.

If the laws of the state would require that all persons selected to have immediate direction of road or bridge construction and maintenance possess practical knowledge and experience, and that this fitness be tested by some sort of competitive examination to be prescribed by a state highway department, acting either directly or thru a civil service commission, the net result would undoubtedly be the saving of many millions of dollars of road revenue and a wonderfully increased efficiency in our road system.

5. Responsibilities should be definite as to persons.

This proposition is aimed at the elimination of our present complex and cumbersome system of road management. If all of this antiquated organization could be swept aside and in its stead one or a few officials endowed with authority and charged with responsibility in each county, the beneficial effects could not fail to be most marked.

6. Continuous employment is more conducive to efficient service than intermittent and temporary employment.

It is so self-evident that a minor defect in a road can be repaired at its inception with little effort, and that if allowed to go on it may require the entire reconstruction of the road surface, that it seems scarcely necessary to urge the soundness of this proposition.

7. The specialists who direct road work should be appointed instead of elected, and they should hold office during efficiency instead of for a fixed term.

The seventh proposition is designed to attract to the work men who look upon road-building as a life profession or occupation. If the right man is in the right place, it is absurd to limit him to a fixed term, for his position is not a reward. The conuty is purchasing his services and is supposed to get value received, and it should continue to purchase so long as he delivers the goods.

8. No road is wholly permanent but requires continuous upkeep, for which financial and supervisory provisions must be made.

A house is not permanent without repair, a railroad track is not permanent without repair, then why should public funds in a large amount be expended in road construction which, without adequate maintenance, may deteriorate to the extent of 50 per cent. in a few years?

9. Cash is a much more satisfactory form of tax than is labor.

If you provide an efficient highway engineer or county superintendent with a modest amount of cash and let him select competent,, efficient laborers, he can quadruple the effective results obtained by the same number of laborers under the old statute system.

10. All agencies at the disposal of the state, capable of use in works of public improvement, should be so used, rather than in such commercial production as would conflict with private enterprises.

The tenth proposition is directed partially toward the convict labor question, and is based upon the assumption that offenders against society owe a debt to society which should be paid in such form as will most benefit society, and the further assumption that honest labor should not be discriminated against thru the sale or disposal of products created by criminal labor. The practical application of this proposition would mean the employment of convicts in road-building, the preparation of road materials, or in other works of public improvement so far as practicable. This proposition is intended also to emphasize the necessity for correlation of the states' various agencies in the interest of road improvement. For example, a state geologist should be helpful in the selection and location of road materials, the laboratories of state universities should be useful in the testing of materials, the university staff should be helpful in the giving of theoretical instruction and in many cases in practical extension work, state bureaus of statistics and agriculture should be helpful in accumulating essential data for the road improvement work in the state, and state civil service commissions should be of very great use in the inauguration and conduct of the merit system in the filling of positions requiring technical or practical qualifications and experience.

Concrete For Paving

By G. W. Pickels, University of Illinois, Urbana, Ill., in Lincoln Courier.

Concrete was first used as a paving material in 1892 and from then till 1912 a total of 4,300,000 square yards was laid in the United States. In 1912 this type of pavement suddenly sprang into favor, and more concrete roads and pavements were constructed than had been constructed in the entire nineteen years preceding. Since then its use has steadily increased, and in 1913 over 8,000,000 square yards were laid, making a total of aproximately 18,500,000 square yards constructed up to January, 1914. For those who are not accustomed to thinking in square yards I will say that 18,500,000 square yards will pave 1,165 miles of 27-foot roadway. This yardage is distributed thru forty-two states, so it cannot be said that the use of concrete is local. It has been used principally in California, Illinois, Maryland, Michigan, Missouri, New York, Ohio, Washington, and Wisconsin.

The three principal types of concrete pavements are (1) the one-course, (2) the two-course, and (3) the bituminous top. Other types which have been used to a lesser extent are Hassam, Blome, Dolarway, etc.

The one-course concrete pavement as its name implies, is laid in one operation. The thickness depends upon the character of the subgrade, the drainage, the traffic, the width of pavement, etc., and varies from 6 to 10 inches. There is probably no other structure composed of concrete that requires as dense and as hard a concrete as does a concrete pavement. To secure this result care must be taken in selecting the sand and stone aggregate, and tests must be made both before and during construction to ascertain the proportions of cement, sand, and stone that must be used to obtain the

FINISHING SURFACE *of Concrete Pavement with wooden floats operated from traveling bridge spanning the pavement.*

densest and strongest concrete. A concrete pavement constructed on the assumption that concrete is concrete and that no more care is necessary in its construction than is required in a concrete sidewalk for example, is almost certain to be a failure. According to the best practice "the fine aggregate should consist of sand, crushed stone, or gravel screenings, graded from fine to coarse and passing when dry a screen of ¼-inch mesh. The coarse aggregate should consist of clean, hard, and durable gravel or crushed stone graded in size, all of which will pass a 1¼-inch screen and be retained on a ¼-inch screen.

The mixing and the placing of the concrete are as importaut as the selection and proportioning of the materials. The materials must be thoroly and uniformly mixed and especial care must be taken to see that they stay uniformly mixed and that the stone and mortar are not segregated after the concrete comes from the mixer. An uneven distribution of the material will take place if the mixture is too wet. One of the most common defects that is noticed in the surface of concrete pavements is the non-uniformity of the mixture, which results in a rough and uneven surface.

Longitudinal expansion joints are placed along each curb, and transverse joints are usually placed from 25 to 50 feet apart. The transverse joints should be protected from excessive abrasion and spalling by two strips of metal, 3 inches wide and 3/16 of an inch thick, having a high abrasion resistance, between which is placed the joint filler, consisting of a prepared felt about ¼-inch thickness and of a width equal to the depth of the pavement.

The concrete is brought to a uniform surface by means of a template resting on the curbs. It is then finished with a wooden float from a bridge spanning the pavement. To prevent the concrete from drying out too rapidly it should be covered with canvas until it has set, and then covered with sand or earth to a depth of about 2 inches, after which it is kept sprinkled for at least two weeks. If possible the pavement should be closed to traffic for a month after it is completed.

Pavements over 20 feet in width are generally reinforced with a triangular-meshed woven wire fabric, placed from 2 to 3 inches below the surface. The purpose of this reinforcement is "to distribute the effect of expansion and contraction due to temperature and the moisture content of the concrete."

The two-course pavement differs from the one-course in that it is not of the same composition for the entire depth and that it is laid in two operations. The first course is called the foundation course or base and is similar to the concrete base used for brick, asphalt, and wood-block pavements. It is generally about two-thirds of the thickness of the entire pavement and is composed of a much leaner concrete than is used in the one-course construction. The second or wearing course is usually composed of two parts of the fine aggregate, such as is used in the one-course pavement, and three parts of clean, hard, and durable crushed rock or gravel passing a ½-inch screen and retained on a ¼-inch screen. This course should be as dense and strong as possible to make it,

and should be laid before the bottom course has set. The function of the top course is to resist crushing and abrasion, and to do this it must be composed of a mass of hard stone firmly held together by a cement mortar.

The failure of concrete pavements of the above type to resist abrasion due to impact has led to the development of the bituminous top concrete pavement, which is nothing more than a pavement of the first or second type—generally of the first—with a thin covering of some bituminous substance which acts as a cushion and to some extent absorbs the shocks of travel. The difficulty that has been experienced with this type is in getting the bituminous covering to stick to the concrete, and because of this its use has been discontinued in some localities.

Approximately 20 per cent of the concrete pavements constructed to date are of the two-course type, and 80 per cent. are of the one-course type. Of the 80 per cent. of the one-course construction about one-half has been covered with a bituminous top.

There are five important factors governing the success of a concrete pavement: (1) Good material, (2) proper proportioning, (3) mixing, (4) placing, and (5) curing. Much stress is usually laid upon the first two items and not enough upon the last three. In fact, a pavement constructed of average materials, proportioned according to some standard ratio, but not tested for density and properly mixed, placed and cured, will usually give better satisfaction than one in which the materials are excellent in quality and correctly proportioned but carelessly mixed, placed and cured.

Concrete pavements are affected very little by rubber-tired vehicles even of the heavier class, but the impact and abrasion of horses' hoofs and of steel-tired vehicles causes considerable wear. If the pavement has been constructed properly so that the surface wears uniformly, no great harm is done; but if improperly constructed, the surface will become rough and uneven and full of depressions.

There can be no question but that the concrete pavement is a valuable type and that its use is certain to increase rapidly. However, judging by our present knowledge and experience, concrete pavements are suitable on streets of moderate travel only. Streets carrying motor traffic or light horse-drawn traffic that in the past have been paved with brick will in all probability in the future be paved with concrete. In comparing concrete with brick, asphalt, wood block, etc., it must be remembered that it is consideraly cheaper, being approximately 25 per cent. cheaper than brick, which is its nearest rival.

Concrete Paving Design

From an article by W. D. P. Warren in Engineering and Contracting.

The purpose of this article is to call attention to the great necessity for the design of concrete pavements.

Engineers have written numerous articles during the past few years concerning concrete pavements, laying stress on the importance of workmanship and materials, and in their endeavor to secure the best results by better workmanship and materials, they have almost ignored the more important item of design. Concrete is subject to certain laws and its behavior has often been demonstrated, both in bridge and building construction.

What are these stresses which cause defects in concrete pavements? Where are they applied? How great are they?

FINISHED CONCRETE ROAD *surface in Wayne County, Michigan; photographed by Universal Portland Cement Co.*

How may they be overcome? These questions may be briefly answered as follows:

Experience has demonstrated that expansion and contraction will cause transverse cracks in a pavement slab 6 inches thick, if the transverse joints are placed 50 feet apart, and that 25 or 30 feet is a safe distance to space them. Joints so spaced and protected by metal plates will free such a slab from any danger of transverse cracks due to contraction and expansion.

Other important stresses tending to produce cracks have been found to act vertically. Vertical motion is produced by the movement of the foundation upon absorbing moisture and again upon drying out. It is produced by the settlement of the sides of the roadbed, where they are less compact than the center. This vertical movement is sufficient to cause the slab to act as a beam.

Hundreds of miles of concrete sidewalk and concrete pavement blocks have cracked longitudinally. They all show failure along the center, or, in cases of extreme width, probably 10 feet out from the gutter line. This teaches but one thing, they were caused by forces acting vertically.

If a concrete sidewalk 4 feet long, 4 feet wide, and 4 inches thick does not crack longitudinally, and yet a block 4 feet long, 8 feet wide and 4 inches thick does crack longitudinally, what is the reason? If a thousand of such blocks crack longitudinally, what is the reason? It is not temperature, stress, contraction, expansion, unknown factor, dished or crowned sub-base, lack of reinforcement, but simply lack of strength in the slab to withstand the vertical movements of the foundation. In other words, for every width of slab, a definite thickness is required. This law is absolutely universal and every longitudinal crack in Wayne county, Michigan, Iowa, Illinois, or any other place, could have been prevented had the slabs been correctly designed.

We know the force of the vertical movements, for if they have caused uniform failures, and if failures have been prevented by a uniform reduction in width of slab to meet the thickness, we know all the necessary facts required to design correctly such a slab to withstand such vertical movements.

One reason why engineers have devoted so little time to concrete pavement design is that pavements have been a gradual growth from sidewalks and private driveways and few people have realized that a concrete slab for such purposes requires a design. Another reason is that the cement and steel people have designed either directly or indirectly many of the pavements and year after year they have proceeded with utter disregard of engineering principles.

The writer attended the National Conference on Concrete Roads, held last February in Chicago, and was in touch with many of the engineers there. It was observed that few came out with a frank admission of failure in design, and yet were more than anxious to learn a means of building concrete pavements without cracks, when it was intimated that such a thing was possible.

In Municipal Engineering for July, 1913, The Morse-Warren Engineering Company, of Carlinville, Ill., discussed the mathematics of concrete pavement design at some length, and later a table was prepared showing the thickness required for certain widths. During the past year, the correctness of design outlined therein has been demonstrated to numerous engineers. While it is true that in rare instances a pavement may be built on a porous foundation which will not be subject to vertical movements, it is poor economy to build any concrete pavement which is not designed to meet general conditions.

There are a few principles of design which, if followed, will produce at an economical cost, a concrete pavement free from cracks. They may be briefly outlined as follows:

1. Transverse and longitudinal cracks are caused by stresses which are greater than the strength of the concrete.

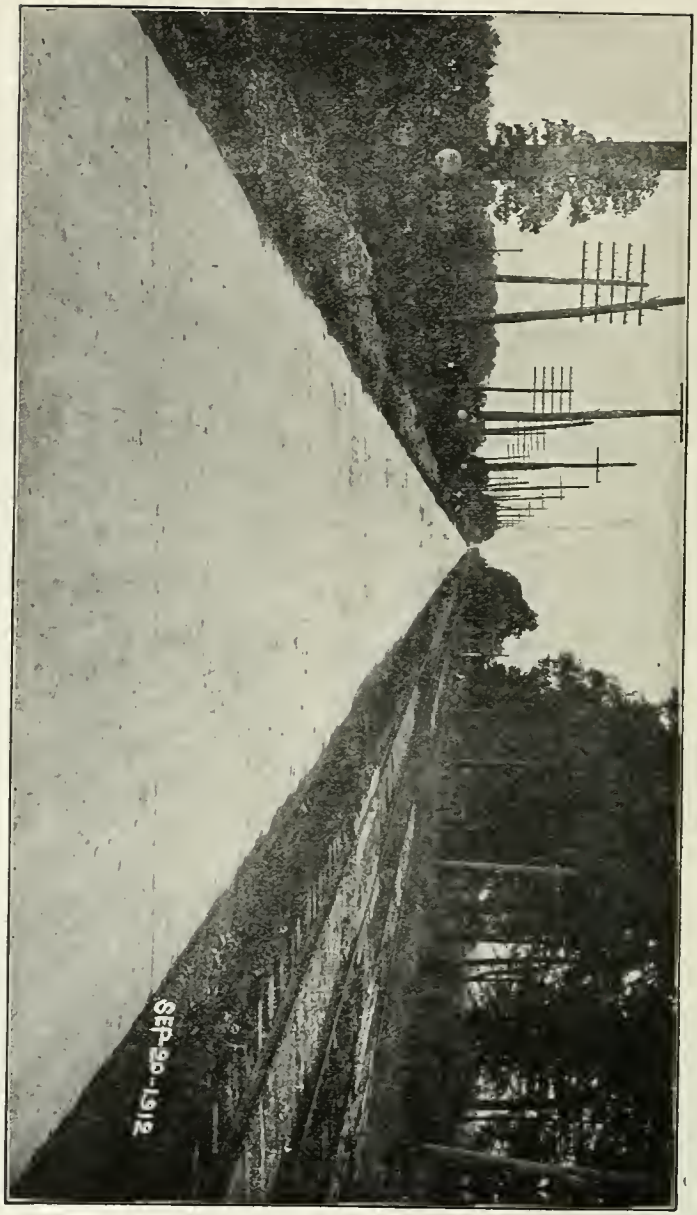
In other words, a slab of concrete, say 4 feet square and 6 inches thick, could withstand the forces of expansion and contraction and the vertical movements of the foundation, even tho they should raise it several inches. It could stand the shock of travel, and the action of the elements; in fact, such a slab would be free from defects.

That the economical slab is much greater in size than one 4 feet square has been demonstrated, and that there is a definite economical size of slab will be more fully explained in this article.

2. Vertical movements in the foundation cannot be economically prevented by additional rolling of the sub-grade nor by drainage.

This principle will be more fully understood when it is known that some of the strongest efforts to reduce cracking by putting the sub-grade in a permanent, immovable, and absolutely stable condition, free from moisture, and free from any tendency toward future settlement, have failed entirely.

Take for instance the sub-grade at the edge of a pavement with a 6-inch tile laid 4 feet deep under that edge. In our section of the country, today, the entire sub-grade is dry. But suppose we have a season of rainy weather, with water



FINISHED CONCRETE PAVEMENT *with transverse joints protected by anchored plates on the system of the Trussed Concrete Steel Co.*

covering the ground in many places. The 6-inch tile will act promptly and proceed to carry off the water, but at the same time the earth at the sides of the pavement will have absorbed moisture, causing it to swell, and the earth under the center of the pavement absorbing less, will swell less, thereby causing unequal movement in the foundation and cracks in the pavement slab. This force acts in the opposite direction when the earth becomes drained at the sides more quickly than at the center. The writer has observed slabs of concrete absolutely supported by a longitudinal ridge of earth, with the edges of the slab extended out into space, so to speak, and acting as a cantilever.

3. Reinforcement is a deception, as geenrally recommended.

Several scientific articles have been published during the last year, calling attention to the fact that any sufficient amount of reinforcement to prevent cracks in concrete pavements is prohibitive in cost; also it has been shown that the per cent. of reinforcement now generally recommended and used is only about one-tenth that ordinarily required.

Many engineers have built reinforced pavements after having had failures in plain concrete pavement construction, and have not taken into consideration the fact that they are getting better results in their later work, not because of reinforcement, but because of better workmanship and material.

A representative of one of the large steel industries after having inspected many miles of pavements, recently informed the writer that he had at last given up the theory that concrete pavements were to be saved from cracking by the use of reinforcement.

The vertical forces tending to destroy a concrete pavement act both upward and downward and yet some material men have the boldness to advertise that a reinforcement placed 2 inches below the top of a pavement will absolutely prevent cracks. If necessary 2 inches below the top it is equally necessary 2 inches above the bottom but the point to be made here is that all such so-called reinforcement is not reinforcement at all; never was figured to be; and never can be anything but an extravagance and a deception.

4. For a given thickness of slab, with good workmanship and material, a definite width is required. The limit of width for a 6-inch slab, 1:1½:3 mix, is 10 to 12 feet, and everywhere you will find concrete pavements with longitudinal cracks where the width is any greater with that thickness.

5. It is economical to make a longitudinal joint in a pavement slab rather than increase the thickness where the width is increased.

If 6 inches is ample to give strength and durability sufficient for travel, it is poor economy to make the pavement any thicker simply to have a continuous beam or slab across the roadway.

Such a longitudinal joint should be protected by a metal plate now manufactured for that purpose. There is no patent on this plate.

6. A joint in a concrete pavement, properly protected and covered by a metal plate is not a weakness.

Engineers have in recent years thrown up their hands in horror at the idea of a joint down the center of a concrete pavement. The fact is that today thousands of taxpayers are throwing up their hands in "holy horror" at the joints in their pavements, joints not planned and not protected by metal plates, which are unsightly, damaging and irregular, and each year increasing the expense of maintenance. As suggested a year ago in one of our leading engineering magazines, longitudinal joints are not to be avoided; they are an absolute structural necessity.

7. A factor of safety should be allowed in design.

The methods of design herein outlined will produce a concrete pavement free from cracks, a pavement costing much less per mile than now recommended by engineers, and a pavement which contractors will with safety guarantee against cracking for a five-year period.

It is the belief of the writer that the design of concrete pavements and the proper protection of a longitudinal joint down the center of the pavement should now receive the attention of the more expert, and that present knowledge of construction should be classified, with the thought in mind that concrete pavement design be reduced to a science.

To those who see the possibilities of the future, and to those who believe that there are defects today in the design of concrete pavements, is submitted the proposition: To design or not to design.

Increase in Highway Construction in 1914

That remarkable progress has been made in the building of good roads thruout the United States during the past few years is proven by data recently obtained by the American Highway Association and soon to be published in the official Good Road Year Book for 1915. It has been found that more than 34,000 miles of surfaced roads have been constructed during 1913 and 1914 and that during the ten-year period from 1904 to

1914 more than 96,000 miles have been completed. That this progress has been really amazing may be understood from the fact that in 1904 there were only 153,000 miles of surfaced roads of all types in the United States. That the movement is attaining momentum as it goes is proven by the fact that while the average mileage construction per annum during the past ten years is 9,600 miles, the total completed for 1914 exceeded 18,000 miles. The report will show that something like 30,000 miles of highway have been completed with the aid of state funds, of which over $200,000,000 have been expended. The state aid movement began in 1892 and has therefore continued for twenty-two years. Only recently has it gotten well under way, as the results accomplished for 1913 and 1914 comprise a total of 10,000 miles of state aid highways completed, or in two years' time one-third of the entire mileage constructed with the aid of state funds has been completed.

Only six states now, out of a total of forty-eight, are without state highway departments and thirty states have granted actual money aid to the building of roads. The year book, which is the official reference publication for all good roads information, is a large cloth-bound volume issued early in each calendar year by the American Highway Association.

Simplified System of Town Highway Accounts

By Fred Buck, Assistant Deputy Commissioner, New York State Highway Department, before the Atlanta Road Congress.

The funds for town highway work in New York state are derived from two sources: First, a tax levied by local officials upon the several towns, this tax being supplemented by moneys paid by the state to the towns for the same purpose, which moneys are known as "State aid," the amount payable to each town being dependent upon the assessed valuation per mile of highways of the town and the amount raised by the town as the highway tax in each year. These moneys combined form what is known as the highway fund.

In the prosecution of the work the town superintendent of highways is the man in charge. He hires the men and teams, purchases materials, directs the work and acts as paymaster; the paying, however, being done by means of vouchers issued by himself as town superintendent, the vouchers being redeemed in cash by the supervisor (who is the chief fiscal officer of the town) and retained by him as a receipt for money paid until the close of the fiscal year, when, upon rendition of his annual report and its acceptance by the town board, these vouchers are filed with the town clerk and become a part of the permanent records of the town. These vouchers, which are furnished to all towns by the state highway department, consist of a printed form with the necessary blank space for the insertion of the date, the name of the payee, the dates on which service was rendered, the number of hours of service or quantity of material, as the case may be, and the road for which it was furnished. Each voucher is attached to a stub upon which are blank spaces similar to those of the voucher.

The supervisor is provided with a supervisor's account book, printed and ruled to receive an entry of each voucher paid, spaces being provided for data relative to the voucher corresponding to that in the body of the voucher itself. Pages are provided at regular intervals for a recapitulated statement of vouchers paid, the data upon these recapitulated pages being finally carried forward to a single page thereon condensed into a form of statement, which is the annual report of receipts and disbursements required of each town supervisor under the highway law. Blank forms are provided for such additional copies of this report as are required to be furnished to the county superintendent of highways, the state highway commission, and the state comptroller.

No other books or accounts are necessary for the town superintendent of highways or the supervisor in properly receiving, disbursing and accounting for the highway moneys of any town than those which have just been described.

With practically no exceptions the town officials are pleased with the form of accounting, and errors and mistakes have been reduced to a minimum so small as to be almost a negligible quantity.

Partial audits of the highway accounts of any town are made by a representative of the state highway department at any time during the year when for any reason it shall be deemed that the same is necessary or expedient. By doing this many errors are prevented which might otherwise occur and unwise or extravagant expenditures are prevented, or checked if begun.

Each year a complete audit of the highway accounts of each town in the state is also made, and it is found that the form of voucher and manner of accounting for the same provided for the supervisor greatly simplify and facilitate the work of the auditor.

It is pleasing to be able to state that, while the audits of the first year in which this system was put in operation showed a large amount of errors and discrepancies (due, mainly, to unfamiliarity with the system or to carelessness in making entries) the audits of the years since the first show a constantly decreasing number of inaccuracies. It is also pleasing to be able to state that extremely few instances of actual dishonesty have ever been uncovered and that in very nearly all cases in which reimbursement has been required the occasion for the same was due to ignorance or carelessness and not to actual dishonesty on the part of any town official.

Those who have been most closely associated with the work are also firm in the belief that the quality of the town highway work of the state as a whole and the very excellent results secured have been contributed to in no small degree by the simplified system of town highway accounting which has been used in connection with the work.

Road Maintenance in Minnesota

In a paper before the Atlanta road congress Geo. W. Cooley, state highway engineer of Minnesota, gives the following as the practice in that state:

The state of Minnesota has given special attention to the matter of maintenance and the present road laws make adequate provision for the care of all roads. Township and county roads constitute approximately 90 per cent. of the road mileage of the state, and of these roads, about 90 per cent. are earth roads. To care for the town and county roads, a one mill tax is levied on all property in the town, the proceeds of which constitutes the town dragging fund. This fund is expended under the direction of an overseer, appointed by the town board, for the purchase of drags, and in dragging all roads of the town, excepting state roads. This appears to be the most satisfactory method of caring for the earth roads under control of the local authorities, but there should be a provision in such cases, for general supervision of the work by the county highway engineer.

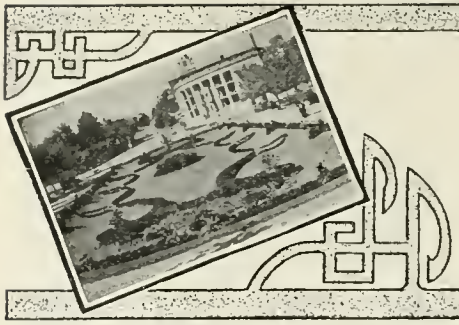
For the care of state roads in Minnesota, 20 per cent. of the state road funds, with a due proportion of county funds, are set aside and may not be used for any other purpose than maintenance of state roads. As the state roads include all types of construction, different systems of maintenance have been required in the different localities. In general, three systems have been established: The patrol system on macadam and well built gravel roads, and the maintenance section system, and road drag system on other roads, all being under the direct supervision of the district highway engineer.

Under the patrol system, one man is assigned a section of from 5 to 7 miles of road and works with hand tools. It has been found necessary to supplement this work with the occasional use of a team and in that manner it has proven satisfactory on macadam and gravel roads.

Under the maintenance section system, one man is given charge of a section of from 20 to 30 miles of road and is employed continuously with his team on the care of his section. He is given authority to employ additional help, both teams and men, and usually has two teams and four or five men at work. Contracts are also entered into by the section foreman with residents along the road, for the dragging of same after each rain, or when ordered to do so by him. The section crew takes care of all minor items of construction, such as placing culverts, etc., and we have found that the work when properly done, is really of a constructive nature. This system is without doubt the most effective, and is being adopted generally thruout the state.

The dragging system requires the employment of a superintendent of maintenance, who for convenience should be one of the engineer's assistants, whose duty is to contract or make arrangements for the dragging of all roads under his charge, and to see that the work is done at proper times. This system is suitable for slightly undulating prairie country, where most of the roads are of earth, and to get best results the superintendent should have at his disposal light graders to reshape the road bed at least at the beginning of each season.

On earth or gravel roads, no maintenance system is complete which does not contemplate the use of planers or similar devices, and a combination of work as outlined under the section system is recommended.



CIVIC BEAUTY

City Planning and A Topographical Map

From a Paper by Mayor Joseph W. Shirley, Topographical Survey Commissioner of Baltimore, Md., before the Engineers and Architects Club of Louisville, Kentucky.

It does seem odd that the separate elements embraced within city planning, such as buildings, railroads, municipal works of all character, are each studied and planned seriously and altogether scientifically. Yet, to the composite whole, there is the minimum of attention. In other words, the smaller things receive our most minute care and the largest thing that man has yet built, a city, is allowed to progress in the most haphazard and care-free way possible.

Out of the number of good recommendations which I read in the report of the Louisville City Improvement Commission, there are two which fall, especially, under the topic on which I am speaking. One is that you must have a good survey and map on which to base any plans for improvement, and afterwards you must endeavor to develop a sensible city plan. Your committee asks for $30,000 for the preparation of this map, hardly a sufficient sum. In Baltimore we made an excellent survey and a map on the scale of 200 feet to one inch with contour intervals of 5 feet, in square mile sections, 38 of them. It shows all essential details for the development of new areas as well as for the rearrangement of the older sections. A complete triangulation of the city based on the general method used by the U. S. Coast and Geodetic Survey was made; precise levels were established over the entire area, and now, after 20 years working on this map, and comparing it to those of other cities I know of no point of importance which was neglected, nor do I think any methods of less refinement could have been adopted to insure the same results.

City planning is construed by many of the unthinking as simply aesthetic plans with the sole idea of preparing for a civic center. Your committee's report grasps the true essence of city planning by considering the necessity for planning for the undeveloped sections of your city. This is something you can now do while you are, at the same time, giving study to conditions needing rectifying in your built up and congested sections. If you do not give proper attention to your growing sections you will very soon find that territory in as bad conditions as are the older portions of your city which were allowed to develop without care or attention. It is a relief to note that the report did not limit itself to the mere rearrangement of governmental and municipal buildings about a central neighborhood. I do not, however, mean to despise any proposal for the grouping of such buildings. There is an extremely worthy motive back of any such movement and one in which you will find you can arouse the greatest interest among the public generally. But to feel that city planning has this for its one and only object is a most serious mistake.

Just before our Baltimore map was made we had annexed a considerable area to the city, about 31.94 square miles. Previous to the time of annexation this territory had been studied according to the old fashioned lights regarding the system of proposed streets, and the streets were for the most part marked by granite monuments at the northeast corners. The lines conformed to the old checker board or gridiron ideas. Fortunately, however, we had a number of good routes of travel leading from the heart of the town to the outlying sections, and the old planners did adopt these routes in their plan of streets. It was realized, however, that the old county plan might not prove ideally satisfactory, and so a commission was appointed to study further this territory and to draw up an official plan. This was all done, and since that time, namely, in 1898, we have worked on the commission's plan of streets for the develop-

ment of our suburban sections. The old plan, viewed from the light of modern practices, was far from ideal and it has been amended and changed so often that its originators would now hardly know their work. I think, at one time, a great many of those having to do with the expansion of the street system in our larger cities felt that they could lay down a definite plan, adhere to it rigidly and, by some as yet unexplainable method, enforce the street plan development on all property owners. Our experience in Baltimore has been that this was indeed a fanciful dream. We have not done it, tho on the whole, I think we have succeeded very well in carrying out the more important elements of the plan. We rely principally on a law which states that the city cannot condemn and open a street nor accept the deed or dedication of any street the lines and grades of which do not conform to the established street plan. In other words, we can not absolutely prevent property owners from laying out their streets along non-conforming lines, but we can and do refuse to grade, pave, lay water mains and sewers or provide lighting in the beds of such streets as are incongruous to the plan, and this, in itself, has had a marked stimulus in limiting haphazard lay-outs.

But in by far the larger area under control of the Topographical Survey Commission the street plan is developed thru a compromise between the city and the property owners. This is, of course, not ideal and no doubt the future will give us more stringent means of developing the street system in conformity with the ideas of the city and not along the lines best suited to the individual property owners.

¶ WIDE, DIRECT THOROFARES *between sections of the city the main object of the Baltimore commission.*

Our main object, however, in the supervision of the street plan, has been to provide for wide, direct thorofares from one section to another and from all sections to the heart of the city. I think we have been fairly successful in this endeavor. We have felt that this is decidedly the most important factor in the development not only of the suburban area, but of the city as a whole. If we can enforce a good system of main arteries we feel that we have done a good work in providing the frame structure to which minor streets may be bound.

A subject of the greatest importance in city planning is transportation. Whatever the means of locomotion, steam, electricity, motor busses, or even air craft, we must have streets, and it seems only proper that the location, widths, extent and all governing features should be considered by men capable of making suggestions founded on proper and scientific study. In other words, let us, at least, try to develop our growing street system as well as we can.

At the same time, let us give study to the rearrangement of our congested and badly arranged internal development. These are the two main factors in city planning.

After the disastrous fire of 1904, Baltimore had an excellent opportunity to hew right and left along the lines affording better street facilities in the congested portion of the city. Those who have had anything whatever to do with any phase of city planning will know how extremely difficult it is to obtain even the smallest improvements. We did some things well and we also left undone some things which we should have done. On the whole, however, I think we can justly feel proud of the results.

The area destroyed in the Baltimore fire was 140 acres. After the improvements, including street widenings and extensions, were completed it was found that more than ten acres in excess of the old streets were used. In the heart of the most valuable property of the city this was quite an item. There were two other important improvements, new municipal docks and markets, which together took out nearly twenty-eight acres more of private property. The total cost of all the improvements in the burnt district was a little over seven and one-quarter millions of dollars. The benefits assessed in the nearby zone were about one and one-eighth millions of dollars, making a net cost to the city of a little over $6,100,000.

Before the fire there were 1,343 buildings which were assessed at a total of nearly thirteen millions of dollars. There are now less than eight hundred buildings, assessed at about twenty-five millions of dollars. So, it can be seen, that altho we wiped out about thirty-eight acres of valuable commercial property at a net cost of over six millions of dollars, we have at the same time practically doubled the value of the improvements now occupying this section. This, it will be understood, is the increased valuation on the buildings alone. As to the increased valuation on the land itself, it is hard to get any definite figures. This is due partly to the under valuation, and generally poor valuation, of the property before the fire. But conservative estimators now place the increase on the land at 50 per cent., at least. A simple

example in arithmetic will show that it will not be very long before the increase in taxes in the district will not only wipe our slate clean, but will give us a good revenue besides."

This is in contrast with the result in San Francisco outlined in the following extract from a paper on the water supply of the San Francisco-Oakland metropolitan district in the September proceedings of the American Society of Civil Engineers, by H. T. Cory, M. Am. Soc. C. E.

"The topography and natural features of San Francisco are such that it could have been made one of the most beautiful cities in the world. Unfortunately, like many other places, it grew 'topsy fashion,' and the layout is rectangular, quite regardless of the configuration of the land. There result grades as high as 22 per cent. The opportunity which the great fire of 1906 presented for redesigning the most important part of the city was not utilized. The city engineer's office recently stated that $26,000,000 was the cost of certain improvements, necessary under the circumstances, but which would have been entirely avoided had the city's planning been adjusted to the topography, as might have been done, and that this expenditure was but the beginning of a series which from time to time must be made."

¶LARGE PLANS *are the only ones which have any chance of success and are the only ones worth while.*

In any campaign for the development of your city along proper lines you will encounter the sometimes embarrassing query as to the net cost and the benefit, if any, from a purely monetary point of view.

Mr. Daniel H. Burnham, the famous designer of the World's Columbian Exposition at Chicago, once said:

"Make no little plans; they have no magic to stir men's blood and probably themselves will not be realized. Make big plans; aim high in hope and work, remembering that a noble, logical diagram once recorded will never die but long after we have gone will be a living thing, asserting itself with ever-growing insistency. Remember that our sons and grandsons are going to do things that will stagger us. Let your watchword be order and your beacon be beauty."

It is hard, however, to convince many citizens that the improvement which you may be considering falls within the category mentioned by Mr. Burnham, and you will often be required to give some kind of estimate of the cost. In a great many cases in city planning this is well nigh impossible and you must have recourse to similar undertakings in other cities. Good city planning has not been applied for a very long time to many American cities and you may be often hard put to it to find a proper analogy. It is, however, often surprising, when the attempt is made to seek such information, to discover excellent suitable examples. For instance, I have just given you the result of a series of street widenings and extensions within a goodly area of the congested and most valuable section of an American city. New York abounds with examples of the improvement to property, its rise in value, and a consequent increase of the taxable basis by the extension of the subways. In a report of the Board of Park Commissioners of Kansas City for the year 1910, there were some most interesting and instructive data regarding the increase of land value due to boulevards. I make the following quotation:

¶INCREASE IN TAXABLE VALUES *is much more than the cost of land and construction necessary for carrying out proper civic improvement plans.*

"The figures given in this report, collected by the board's accountant, show the powerful influence which the establishment of the boulevards has had upon land values. On Benton boulevard, upon which the abutting property has responded in a less degree in increments of value than on any other boulevard of the city, it is shown conclusively that the increase in value has been more than 183 per cent. since the establishment of the boulevard, and that after deducting the cost to the property owners of every class of improvements with which this frontage has been assessed, and also deducting the average increase of land value thruout the entire district, which includes increments due to this and other park improvements in the same district, we have a clear net profit, demonstrably due to the boulevard, of approximately 44 per cent. But upon other boulevards, notably Armour, Gladstone, Linwood, Gillham Road and The Paseo, the land gain has been from 200 to 500 per cent., the greater portion of it being directly attributable to the establishment of the boulevards."

And so in various municipalities you will find concrete examples tending to show even to the most sceptical that city planning pays in dollars and cents as well as in the general comfort and living conditions of the citizens.

Unfortunately we have no good examples of the results of excess condemnation. This method for the improvement of our municipalities is thought by some of the best experts in city planning to be the real key which will give to American cities a method and stimulus for large neighborhood improvements. Mr. Andrew Wright Crawford, who is intimately associated with the National Conference on City Planning, has given a good deal of study to this subject, and I think his published discussions on the matter are well worth the reading for those interested in civic improvements. Your committee, I note, made reference to excess condemnation in its report. I think all those who have given the matter any attention at all are highly in favor of adopting excess condemnation. But to put it into effect in most cities we will need additional and different kind of legislation. Europe has done wonders in excess condemnation, Germany being probably to the forefront in carrying out such principles. But to Americans interested in the subject, the form and methods adopted in England would probably appeal more strongly than would the methods adopted on the continent. London has issud a most interesting report on the creation, by excess condemnation, of the King's way. You will find this good reading and I think some of the ideas you will find possible to adopt in your plans for Louisville. We shall, of course, have to modify to a great extent the methods which the English adopted, but I can see no good reason why we should not begin to strive to obtain this much needed power in civic condemnations.

¶STREET TREES *and cross sections and like details are essential parts of civic beauty plans for they reach all streets and make them conform to the special beautifying features of parks, places and boulevards.*

Do not forget the details in your city planning. You must never lose sight of the importance of parks and boulevards nor must you forget the importance of the planting of trees along your streets. Within the past few years the progressive American cities have given much attention to forestry departments. The results in many communities have been most gratifying. Washington, of course, is almost ideal in this line. In Baltimore we are on our second year in this work. I do not mean, of course, that previous to this time trees were not planted on city streets, but two years ago we had prepared new legislation and created a separate city department to care for all matters pertaining to the planting, preserving and caring for street trees. The department has been a great success and each year will show more clearly the wisdom of our move. I hope you will see your way clear in Louisville to devote a good deal of time to this great adjunct for the beautifying of your city.

Still another detail which I think you would do well to keep constantly in mind in your future planning for Louisville is that of the cross-sections of streets. Baltimore, following the custom on vogue in many of our older cities, for many years constructed its streets along a general rule of thumb procedure, whereby one-fifth of the total width between building lines was used for each sidewalk and the remaining three-fifths wa sdevoted to the roadway. On some streets this proportion and allotment figured out very well, but on others it was decidedly bad and totally inappropriate, for it entailed the paving of a roadway much too wide for the needs of the traffic. Now, however, we have gotten away from such a poor method, or, rather, lack of method, of procedure and we new endeavor to adjust our cross-section to meet the demands of the thorofare in question. This is, of course, all a very simple matter, but I mention it as simply one of numerous details requiring attention in order to get the best results in your efforts at city planning.

I realize in the talk I have been giving that I have not laid as much stress as one might have thought proper on what I mentioned in the first place, that is, a topographical map as a basis for good city planning. But I have allowed myself to drift from the subject principally for the reason that from the nature of your profession I know full well that you do appreciate the absolute need of such a map in all forms of city planning, and I have thought it little use to dwell on the importance of something which you know yourself much better than I could possibly make known to you.

MISCELLANEOUS

An Aquatic Capital

The photograph on the front cover page shows the city of Brunei, which is the capital of the state or province of Brunei on the Island of Borneo. All the houses in the city are built on slender piles made from the Nihong palm, driven in the bed of the Limbang river, which evidently does not vary greatly in stage. It will be noted that the islands and the banks of the river are heavily wooded and are apparently not inhabited, the people preferring to locate their houses over the water.

The inhabitants are Malays, Kadayans, Orang-Buskits and a few Muruts, whose business is mainly trading with tribes living in the interior of Sarawak and British North Borneo. Their manufacturing industries are brass working, in which they are very skillful, and weaving cloth among the women. Agricultural activities are mainly limited to the growth of sago and rice in the valleys nearby.

A hundred years ago this city was the headquarters of the Borneo pirates and a center for the slave trade.

The municipal problems of such a city are many of them much simpler than those of a city on land.

Municipal Four Per cents at Par or Better

On November 9, 1914, the city of Philadelphia, Pa., sold $825,000 of four per cent. bonds over the counter at par before 11 o'clock of the first day of the sale, and when the offering was increased to $1,125,000 it was all sold within ten days, without any aid from banks. This repeals the city's experience of May 1, 1913, when an offering of $3,500,000 of four per cent. bonds was quickly taken and the offering was increased to $4,125,000 to meet the demands of purchasers. These sales are of part of an authorized issue of $7,000,000 of bonds for public improvements.

In July $1,500,000 was offered for competitive bidding and was sold at about 102.1 to 102.2.

The city of Indianapolis did not find the retail sale of bonds successful, but placed one issue of $63,000 at a bid netting 3.99 per cent. interest.

That contractors and material men are anxious for work is shown by the report that at a letting for a small water works plant in northern Indiana there were 86 bidders present and 110 bids were offered requiring about four days to tabulate and compare to determine the successful contractors.

Lecture Courses for Health Department Employes

The department of health of the city of New York has organized series of lectures on sanitary science for its employes in four courses: For medical inspectors and other physician employes, 18 lectures; for lay food and sanitary inspectors, 24 lectures; for hospital nurses, 60 lectures; and for field nurses on infectious diseases and child hygiene, 20 lectures. All the lecturers give their services gratuitously.

Lectures can be obtained by organizations outside of New York on application to the Lecture Division of the Bureau of Public Health Education, Department of Health, 139 Center street, New York. It is understood that there is no charge for these lectures, tho all expenses of the lecturer and stereopticon, if used, should be paid.

Technical Schools

The University of Illinois maintains ten research fellowships in its engineering experiment station, open to graduates of approved American and foreign universities and technical schools. Appointments must be accepted for a period of two years and holders receive $500 a year. Half time is spent in the station and half time may be spent in graduate study leading to master's degree. Four vacancies occurring next spring will be filled in March from applications made during January, 1915.

The educational institutions in Cambridge, Mass., at the request of Mayor Good, have appointed advisors for the city on matters of taxation. Harvard University appointed Prof. Charles J. Bullock, a prominent authority on economics, and the Massachusetts Institute of Technology has appointed Prof. Chas. M. Spofford, head of its civil and sanitary engineering department.

The second annual short course in highway engineering of the University of Illinois will be given January 11 to 23, 1915. Several state highway engineers, professors, county superintendents of highways, township highway commissioners and road experts are on the list of speakers. Afternoons will be spent in laboratory demonstrations in testing materials, mixing concrete, etc.

"The Analysis of Coal with Phenol as a Solvent," by S. W. Parr and H. F. Hadley, has just been issued as Bulletin No. 76 of the Engineering Experiment Station of the University of Illinois.

American Road Builders' Convention

The fifth American Good Roads Congress and sixth Good Roads Show held by the American Road Builders' Association at Chicago, December 14 to 18, was well attended and both were most interesting and instructive. The distance apart of the two attractions interfered somewhat with the attendance at both, those having special interest in one finding it difficult to attend the other. The registration at the road show seems to have been about 1,500, which by no means measures the attendance, and the total registration was estimated as approximately 4,000.

The Congress was addressed by state, county and city highway commissioners from Wisconsin, Illinois, Ohio, New Jersey, New York, Colorado, Ontario, Arkansas, Pennsylvania, Connecticut, Massachusetts, Kentucky, Indiana, Iowa, Maryland, Michigan, New Mexico, Kansas, West Virginia, Louisiana, North Carolina, Maine.

The discussions covered all branches of the road problem; construction features, such as dimensions, foundations; organization, of department and divisions; traffic tendencies, development and regulation; machinery of construction and maintenance; brick, concrete, wood, stone, bituminous, earth and gravel surfaces for roads and bridge floors, standards of specifications and construction, legislation, convict labor, dust prevention and street cleaning.

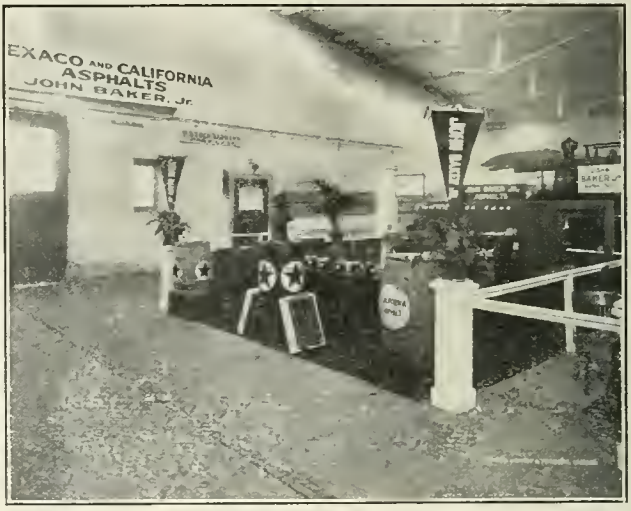
About 125 manufacturers and dealers in road machinery and materials were represented by exhibits, many of them being handsome as well as interesting and instructive. Six photographs of exhibits are shown in the accompanying cuts, which with their titles are self-explanatory.

The educational features of the show were located about a small park and boulevard constructed in the center of the arena at the main entrance to the building. The "boulevard" was paved with sample sections of various pavements including Aztec asphaltic concrete, of the U. S. Asphalt Refining Co., brick and creosoted wood block with Sarco filler and concrete surfaced with Sarco asphalt of the Standard Asphalt and Rubber Co., asphalt macadam and brick pavement with Standard asphalt and filler of the Standard Oil Co., asphalt macadam using Bermudez asphalt and asphaltic concrete paving using Trinidad lake asphalt of the Barber Asphalt Paving Co., Warrenite and bitustone pavements of Warren Brothers Company, Tarvia filled macadam with granite and limestone wearing surfaces of the Barrett Manufacturing Co., concrete of the American Portland Cement Manufacturers' Association, wire-cut-lug brick of the Dunn Wire-Cut-Lug Brick Co., Kreolite and hex wood blocks of Jennison-Wright Co., creosoted wood blocks of the U. S. Wood Preserving Co., Kettle River Quarries Co., Chicago Creosoting Co. and Ayer and Lord Tie Co., granite blocks of the Wisconsin Granite Co. and tarvid of F. J. Lewis & Co.

A boulevard lighting system and street signs of the Enamel Sign Co. of Chicago, added to the general beauty of the exhibit. The exhibits of the Chicago street department, the U. S. Office of Public Roads and highway commissions of several states and cities surrounded the boulevard.

Materials of construction and machinery were separated into the two groups. Exhibitors of materials included asphalts by Barber Asphalt Paving Co. with a moving picture show, see one of the accompanying photographs; U. S. Asphalt Refining Co.; John Baker, Jr., with Texaco and California asphalts, as seen in one of the photographs; Bitulithic by Warren Brothers Company, as seen in one of the photographs; Tarvia by Barrett Mfg. Co. with a moving picture show; Rocmac by the Rocmac Road Corporation of America; Glutrin by the Robeson Process Co.; brick by The Dunn Wire-Cut-Lug Brick Co., with their daily carnations for every visitor, and the National Paving Brick Manufacturers Association, both shown in one of the accompanying photographs; concrete building and road reinforcement and joint protectors by Trussed Concrete Steel Co., as shown in one of the photographs; as-

Trussed Concrete Steel Company, Detroit, Mich. Concrete reinforcement curb and joint protectors and waterproofing.



John Baker, Jr., New York. Texaco and California Asphalts.

Warren Brothers Company, Boston, Mass. Bitulithic, Bitustone and Warrenite pavements.

EXHIBITS AT CHICAGO ROAD SHOW.

phalt paving plants by F. D. Cummer & Sons Co., by photographs and booklets; cement by Universal Portland Cement Co.; creosoted wood Kreolite and Hex blocks by Jennison-Wright Co.; Sarco asphalt for asphaltic concrete, expansion joints, filler for block pavements, wearing surface for concrete pavements, etc., by Standard Asphalt and Rubber Co.; inspection facilities for construction and materials by Robert W. Hunt Co.

In the machinery exhibits the Koehring Machine Co. had a prominent place with their paving mixers No. 6 and No. 16 one of them shown in an accompanying photograph; the Utility Road and Farm Machinery Co. with their Clark grader and trenching machine, Kelly-Springfield Motor dumping trucks; Austin-Western Machinery Co. with their new gasoline road roller; Erie Machine Shops with their new Erie steam roller; the Jaeger Machine Co. with their paving mixer; Knox Motor Co. with photographs and booklets regarding the tractor; Marsh-Capron Co. with their concrete machinery; Steel Protected Concrete Co., with their Wainwright steel protected curb; Turbine Sewer Machine Renovating Co., with their sewer cleaning machinery and photographs of results.

Limitations of space prevent completion of the list of which the above are representative.

Personal Notes

Arthur W. Dean, M. Am. Soc. C. E., chief engineer, Massachusetts Highway Commission, Boston, Mass., on December 3 delivered a lecture on "Specifications for Sizes and Physical Properties of Broken Stone," before the graduate students in Highway Engineering at Columbia University.

Sumner R. Church, manager, Research Department, Barrett Manufacturing Company, New York city, on December 7 delivered an illustrated lecture on "The Essential Physical and Chemical Properties of Creosote Oils for Wood Blocks," before the graduate students in Highway Engineering at Columbia University.

A. W. Dow, chemical and consulting paving engineer, New York city, on December 6 delivered an illustrated lecture on "Details of Construction of American Wood Block Pavements," before the graduate students in Highway Engineering at Columbia University.

George W. Tillson, M. Am. Soc. C. E., consulting engineer to the president of the Boro of Brooklyn, New York city, on December 11 delivered an illustrated lecture on "European Wood Block Pavements," before the graduate students in Highway Engineering at Columbia University.

George Prentiss Robinson, C. E., has retired from the office of city engineer of Santa Barbara, Cal., where he has had charge of extensive paving improvements, a 2,000-foot sea wall and several bridges. He returns to the general practice of civil engineering at 849 N. Mariposa Ave., Los Angeles, Cal.

John G. Evans has joined the sales force of the Marquette Cement Mfg. Co., at their Chicago office.

Technical Associations

The sanitary section of the Boston Society of Civil Engineers will meet January 6 and hear talks on "Diatoms" by Prof. Geo. C. Whipple, of Harvard University; F. F. Forbes, superintendent of water works at Brookline, and others. S. E. Tinkham, secretary.

The engineering section of the American Association for the Advancement of Science, meeting in the Engineering Building of the University of Pennsylvania, in Philadelphia, has a long program of papers for Wednesday and Thursday, December 30 and 31, which sustains the reputation of this organization for excellent work, tho it is evidently impossible to read all the papers or to discuss any considerable number of them in the time allotted.

The American Wood Preservers' Association will meet January 19 to 21, at Congress Hotel and Annex, Chicago, Ill. This is a working association whose value is demonstrated to engineers generally by the annual volume of proceedings. Membership is open to all engineers, professors, editors, producers of materials and others interested in the work covered by the title of the organization.

The twelfth annual dinner of the Municipal Engineers of the City of New York will be held January 16, at the Hotel Savoy, at 7 p. m. Geo. A. Taber, secretary.

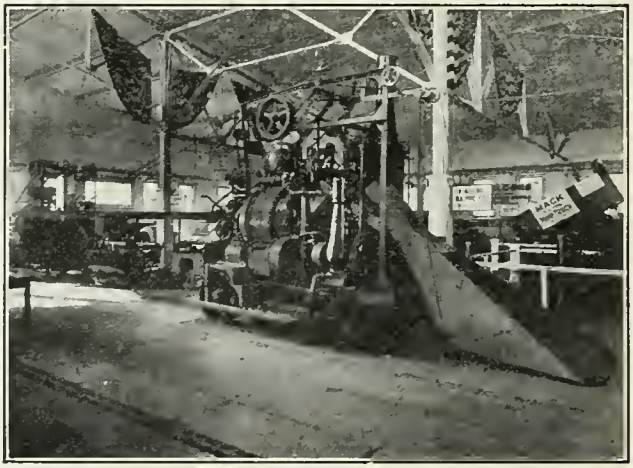
The second National Foreign Trade convention, to be held in St. Louis, January 21 and 22, has for its objective greater prosperity thru greater foreign trade. Hon. W. C. Redfield, U. S. Secretary of Commerce, and John Basset Moore, formerly counselor of the U. S. Department of State, will open the convention. Authoritative papers by leaders in the business world, constructive discussion by delegates from all parts of the country, and ways and means for the smaller manufacturer and merchant to engage in foreign trade are the features of the program.

The special railroad rates for the Panama-Pacific and the Panama-California expositions at San Francisco and San Diego go into effect March 1, and are on the basis of $50 for the round trip from Missouri river points.

The Engineers' Club, of Dayton, O., he-

Dunn Wire-Cut-Lug Brick Co., Conneaut, O., and National Paving Brick Manufacturers' Association, Cleveland, O. Brick pavements.

Barber Asphalt Paving Company, Philadelphia, Pa. Trinidad Pitch Lake and Bermudez lake asphalts, asphalt pavements and bituminous surface roads.



Koehring Machine Company, Milwaukee, Wis. Concrete mixers and distributers.

EXHIBITS AT CHICAGO ROAD SHOW.

gan its life practically on May 14, 1914, in a handsome clubhouse at Second and Madison streets, and is a new idea for a technical association outside the largest cities. It has already made itself felt in the city, and its influence can be extended indefinitely. The club will be the host of the American Society of Municipal Improvements at its convention, to be held in Dayton, October 18-22, 1915.

At the annual meeting of the American Society of Mechanical Engineers, held in New York, the sessions of December 3 were devoted to engineering in the administration of a city, with papers by prominent officials in the engineering departments of the cities of New York, Philadelphia, St. Louis and Cleveland, and others.

The American Society of Engineers, Architects and Constructors, at its monthly meeting, held in the United Engineering Societies Building, on Thursday, December 10, passed the following resolution: "That in view of the complex nature of modern engineering and architectural construction, which demands practical knowledge far in excess of the limits of one man, it is desirable, in the interests of our cities, that their municipal authorities should at times call in the assistance of experts for consultation with their own engineers."

The third annual meeting of the Montana Institute of Municipal Engineers will be held in Helena, Mont., January 18-20. Carl C. Widener, secretary, Bozeman, Mont.

At the annual meeting of the Brooklyn Engineers' Club J. S. Langthorn was elected president; G. Laurence Knight, vice president; Joseph Strachan, secretary; W. W. Brush, treasurer.

The Ohio Engineering Society will hold its thirty-sixth annual meeting January 20-22, in Brown Hall, Ohio State University, Columbus. The program includes papers on inclosing a stream thru Mansfield, by C. L. Bradley; an experiment in resurfacing a concrete road, by F. J. Stinchcomb, county surveyor, of Paulding; wire-cut-lug brick, by W. C. Perkins; culvert design, by P. K. Sheidler, of the state highway department; brick roads, by D. Meomaw, road engineer of Cuyahoga county; a recent public utility franchise, by Charles C. Brown, of MUNICIPAL ENGINEERING; the relation of the engineer to plans and work, by Will P. Blair, of Cleveland; the National Road, by J. T. Voshell, of the U. S. Office of Public Roads; the state highway department, by James R. Marker, commissioner; the Columbus sewage, garbage and water treatment plants, by Prof. F. H. Eno. John Laylin, of the state highway department, is secretary.

At the annual meeting of the New England Water Works Association, Desmond Fitzgerald will show and describe some travel lantern slides, and the report of the committee on filter statistics will be made and discussed. The president, Frank A. McInnes, will deliver his annual address and officers will be elected. The meeting will be held at Hotel Brunswick, Boston, Mass., January 13.

Publications Received

Water Supplies; Their Purification, Filtration and Sterilization; a handbook for the use of local and municipal authorities, by Samuel Rideal, D. Sc., fellow of University College, London, and of the Institute of Chemistry; public analyst for the metropolitan boro of Chelsea; and Eric K. Rideal, B. A., Ph. D., with numerous illustrations and tables. American publishers, D. Appleton & Co. Cloth, 274 pp.

Report of the fifth annual meeting of the Commission of Conservation of Canada, held at Ottawa, January 20, 21, 1914. Clifford Sifton, Chairman, Ottawa, Can.

Graphic Methods for Presenting Facts, by Willard C. Brinton, is one of the volumes of the Works Management Library, published by the Engineering Magazine Company, New York. Cloth, 370 pp. $4.

Civil Service Examinations

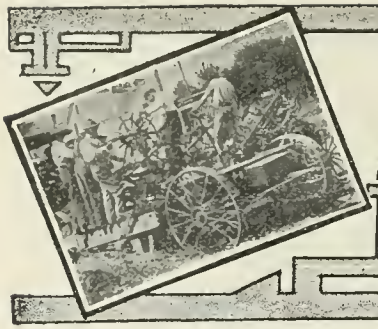
The United States Civil Service Commission will hold examinations at the usual places, as follows:

February 2: Sanitary engineer in Public Health service in the field at $2,500 a year.

February 3: Physical laboratorian in New York navy yard, at $3.04 a day; copyist marine engine and boiler draftsman in Norfolk navy yard, at $2.80 a day; copyist electrical draftsman in New York navy yard, at $3.28, and in Philadelphia and Puget Sound navy yards, at $3.04 a day; copyist ordnance draftsman in Washington navy yard at $2.80 a day; civil engineer student in the Office of Public Roads, at $720 a year; temporary topographic and under Geological Survey during field season, at $40 to $75 a month.

February 3, 4: Marine engine and boiler draftsman in Philadelphia navy yard, at $5.04 a day; electrical draftsmen in navy yards and establishments, at $3.52 to $5.52 a day; ordnance draftsman in any U. S. navy yard or establishment or in Washington, at $3.28 to $5.04 a day; structural steel draftsman at Newport naval station, at $4 a day.

February 4, 5: Junior topographer in Geological Survey, at $720 to $1,200 a year.



MACHINERY AND SUPPLIES

Street Signs and Sign Posts

In the December number of MUNICIPAL ENGINEERING, vol. xlvii, p. 482, is an article describing and illustrating very simple and economical as well as low priced designs for posts for street signs of various sorts and the enameled signs used on the posts. The paragraph giving the name of the company was lost from the copy for the article and so due credit was not given for the supply of a design which only needed to be known to become popular for general road work.

The Enameled Steel Sign Co., 222 North State street, Chicago, Ill., can supply the signs and will send on request a booklet giving full information about them and the prices at which the various designs can be furnished.

New Road Asphalt Paving Plant

R. L. Davis, contractor, Tampa, Fla., has just purchased a Cummer road asphalt paving plant to be used first at Tarpon Springs, Fla., for sand-asphalt roads. After completing this contract it will be shipped elsewhere for laying asphalt macadam.

This plant is especially adapted for this class of road work, because it consists of three units, power, asphalt kettles, drying and mixing; and each unit is mounted on its own trucks with broad wheels, making the complete plant easily moved along the road, and kept up with the work.

The capacity of this plant is about 1,000 yards of 2-inch sand asphalt topping per day, or the equivalent of sheet asphalt, asphalt macadam or Topeka mix.

The plant will immediately be put into commission. This is the fifth plant of this type to be shipped South this season for sand asphalt roads and sheet asphalt, asphalt macadam and Topeka mix pavements. They come from the F. D. Cummer & Son Co., Cleveland, O.

The plant is designed for moving along the road, to be kept up with the work, or to be jacked up and used in the following manner: When moved along the road, the mixture is taken away by means of wheelbarrows, and when it is jacked up, the mixture is taken to the work on the streets or roads in wagons or auto trucks.

There are also many of these road plants in operation in the East and Middle West.

A Damp Resisting Paint

Antkawa damp resisting paint is an indestructible compound of water-resisting and alkali-proof materials scientifically combined, which when applied to the inner walls of brick, stone, cement or tile, dispenses with furring and lathing.

Being plastic in its nature, it expands and contracts in unison with the surface to which it is applied and permits scratch coat of plaster to absorb sufficient so as to form a permanent bond between the wall and the plaster.

Applied on the interior of walls it seals them, making an air-tight, heat and cold insulating barrier, thereby reducing the radiation necessary for the heating of the building.

There being no space between wall and plaster, vermin are eliminated and a sanitary fire-proof construction is secured which not only economizes in space, but cost as well.

Antakwa prevents the alkali and saltpeter from penetrating the plaster and staining the decorations.

For plastering direct to Antakwa damp resisting paint, the surface should be clean and dry and masonry pointed up to a reasonably smooth condition. Paint should be applied with a stiff brush, care being taken that no minute pinholes are left uncovered. After application of a good continuous coat a second or retouch coat is given to bring the surface to a uniform blackness. Plaster can be applied twenty-four hours after.

A recent problem of this nature was stated as follows to The Antakwa Company, 403 Chamber of Commerce build-

ing, Chicago, Ill., the makers of the paint:

"We have about 50,000 square feet of faced brick on the interior walls of our new pumping station, the brick being a hydraulic dry pressed brick, buff in color. A great amount of efflorescence showed on the surface of this brick, all of which has recently been cleaned off, but in order to prevent a reoccurrence of this discoloration we are desirous of coating the brick with some transparent, colorless preparation which will prevent any exudation in the future.

"Understanding that you are manufacturers of the material to be used for the purpose indicated, I would be pleased to hear from you with full particulars regarding your product, giving the price, the amount required, and the guarantee which you would give with said material to prevent any further discoloration on the brick wall. I would also be pleased to know whether you would prefer to do the work yourself or whether the material can be applied by any skillful painter."

The application of Antakwa in two coats, which can be made by any good painter, will cure the difficulty at a cost of about 1 cent a square foot of wall, the covering capacity of Antakwa being 125 to 150 square feet per gallon for two coats.

The paint has been used in many hospitals, schools, apartment houses, theaters, office and college buildings for waterproofing and damp-proofing purposes, one large academy building requiring 5,750 gallons, tho 600 to 1,200 gallons is the usual amount applied in buildings of the classes named.

The Antakwa Company will give full detail as may be desired.

See America First New Year's Greeting

We are wishing you a pleasant journey through the coming year—

A jonrney that shall not be marred by skidding—

A journey in which there may be few rongh spots—

A journey in which yon may have Safety First, last and all the way—

A journey which may enable you to See America First in the galaxy of nations—

First in prosperity, First in Peace, and First in Honor—

A journey that shall bring you all the comfort, all the safety and all the steady going that accompany Goodrich Tires—

A journey during which every day may be a continuous round of pleasure—

Just as each Goodrich Tire is.

And may all your ventures prove to be for the Best in the Long Run.

The B. F. Goodrich Company,
Makers of Everything that's Best in Rubber.

A Safe and Tight Manhole Cover

The accompanying cut shows the D. and D. safety cover for manholes and its construction, so as to demonstrate that the design is one which prevents all rattling or dishing of manhole covers under street traffic. The lugs shown in the cut fit into each other very snugly and prevent any noisy motion.

The South Park Commissioners of Chicago have installed the covers on some of the South Side boulevards, made of the Chicago city street manhole size, weighing 540 pounds complete. They are also in use by the electrical department of the city of Chicago and by the water department. The dimensions of the 540-pound cover are 24-inch diameter of opening, 36-inch diameter of bottom flange.

Except for the more perfect fit of the lid, the cover is in all respects the same as the ordinary manhole required by Chicago specifications. The advantage is in the tightening and wedging of the lugs on the lid upon the lugs on the inside of the manhole ring.

The lid is as easy to remove as the ordinary manhole cover lid, because the lugs are so constructed that frost or dirt do not affect the removal.

The difference in difficulty of making the castings makes the price a little higher than the ordinary cover, but its safety from tipping and the absence of rattling more than make up for the small difference in cost. Cities adopting it will at once appreciate its good points. Coal-hole covers, water caps or any like manhole covers are safer if of this design.

The cover is put on the market by Wm. E. Dee Company, Stock Exchange building, Chicago, Ill.

Steam Melting Asphalt Plant

Some years ago, certain advanced asphalt experts discovered that asphalt, after having been overheated, lost the greater part of its usefulness.

The Merriman plant was equipped with steam coils to prevent this destruction, and for a period of ten years, no asphalt pavement that was mixed by this plant has either gone to pieces totally, or in patches, on account of burned asphalt having been used in the mix.

It has demonstrated its capacity of 2,800 sqnare yards of 2-inch sheet asphalt top in ten hours and a corresponding proportion of asphaltic concrete. The mixer is the equivalent of 12 cubic feet. All power transmission is protected from the fine sand and the cost of repairs has been very low as a consequence.

The East Iron & Machine Company, of Lima, O., will furnish any further information regarding this plant.

Watson Corrugated Culvert Patent Valid

The large number of manufactnrers of corrugated culverts in the United States operating under the Watson patent, have just been informed by their attorney, Wallace R. Lane, of Chicago, that the United States Court of Appeals for the second Circuit, having final jurisdiction, has just handed down a mandate reversing the lower court and holding the Watson corrugated culvert patent valid and infringed by the culvert installed by a highway commissioner in New York. In brief, the court holds:

"The Watson patent has been so thorely discussed in the opinions of the District Court and of this court, that it will serve no useful purpose to repeat in detail what is there said regarding the patent and the disclosures of the prior art. The patent is for a corrugated metal culvert. It is unusually plain and simple.

"In brief,, the claim is for a sheet metal culvert composed of connected cylindrical sections having circumferential corrugations extending to the extremities of the sections. Each section terminates at one end in a flared and at the other end in a contracted portion of a corrugation, so that two sections may interlock, the ends being held in place by bolts or similar means: The corrugations greatly strengthen the culvert and the doubling of the corrugations at the joints braces and adds stability in the structure.

"In short, the patented culvert is cheap, strong, durable, easily transported, quickly laid down and easily repaired.

"We cannot believe that the man who gave such a structure to the world should be denied the title of an inventor.

"The fact that Watson, during the early years of his patent was almost invariably repulsed by those interested in the art because they thonght his device empirical, inefficient and perishable, is persuasive to the conclnsion that his improvement was not obvious.

"In view of the phenomenal success of the patented pipe after the public became aware of its advantages and the strength and durability which it has developed after years of trial, we are of the opinion that any doubt as to patentability should be resolved in favor of the patent.

"The practical and commercial success of the Watson culvert is so clearly shown that we find it difficult to believe that a mere mechanic could have produced a culvert which has so revolutionized the art, a culvert which has shown a durability which no one at the time of the invention thought possible.

"We have here not only the circumstances that the new device has commended itself to the public and gone into extensive use. This sometimes happens because of judicious advertising and clever business methods.

"The early history of the patentee's experience is illustrative. For years after the issue of the patent he labored unsuccessfully to introduce his culvert. The persons whom he urged to try his device, persons engaged in road building and under-draining, declined to do so because it seemed to them very doubtful whether it would endure, and opposition was overcome only after he had actually built a few culverts and demonstrated their capacity to remain efficient after years of use. This circumstance indicates that simple tho it is, the Watson culvert is a device which would not have suggested itself to the ordinary road-builders.

"Infringement is clearly shown; the two structnres are almost identical and the only differences are of form and not of substance. The defendant passes the rivets thru the metal at a point further from the ends of the section by less than an inch than in the complainant's structure. The difference is trivial and nothing functional is accomplished thereby.

"The decree is reversed with costs and the cause is remanded to the District Court with instructions to enter a decree for the complainant in the usual form."

The manufacturers of corrugated culverts under this important patent, including the National Corrugated Culvert Mfg. Co., of Middletown, O., make them out of Armco American ingot iron.

Waterproofed Coatings of Surfaces

Before applying the waterproofed coating the surfaces must be especially prepared that a suitable bond be obtained. In fact, this preparation of surface is most important and many of the past failures in the application of the process may be attributed to the lack of care in this operation.

The proper bonding face is obtained by thoroly roughening, cleaning and grouting the surface. The wall or floor slab must be saturated with clean water to destroy excessive capillarity, for otherwise the pores of the masonry will absorb a large percentage of the gaging water, together with the finer particles of cement, and the strength and efficiency of the coating be impaired. Particularly in the case of brick walls or floors should the members be thoroly wet down, owing to the great absorptive property of this material. A slight amount of absorption is desired, however, as it assists materially in obtaining the necessary bond.

In the case of concrete walls the entire face is chipped to expose the aggregate, while for brick and rubble the joints are raked and the surfaces roughened. For floors it is highly advantageous to apply the waterproof coating the day following the placement of the concrete slab in order to simplify the bonding operation. When the coating is applied over old concrete floors similar precautions as for walls must be observed.

The cement coating is prepared by an intimate mixture of Portland cement and coarse sand with the incorporation of an Integral waterproofing compound, such as Trus-Con Waterproofing Paste, made at the Trus-Con Laboratories, Detroit, Mich. Proportions of 1 part cement to 2 parts sand are best adaptable for the purpose, as mixtures considerably leaner than this are too porous, whereas coatings of richer mixtures have a tendency to crack under temperature changes.

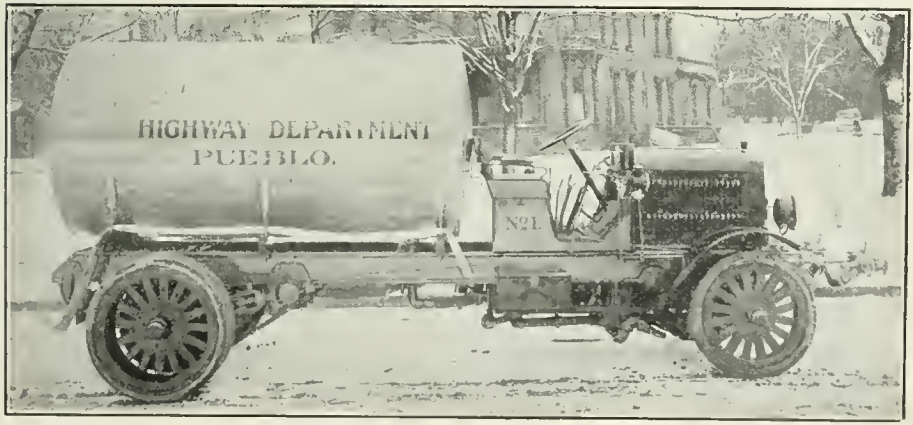
For waterproofing vertical surfaces the coating is applied in two coats, scratch and finish, giving a total thickness of ¾ to 1 inch, while for horizontal surfaces the coating is placed in one operation 1 to 2 inches in thickness. The second coat for vertical surfaces should follow the first at an interval not exceeding eighteen hours under normal conditions, as after final set has taken place, the pores of the waterproofed scratch coat, being negative in capillarity, tend to repel the grouting particles of the finish coat, resulting in a lack of adhesion.

Pueblo's New Street Sprinkler and Flusher

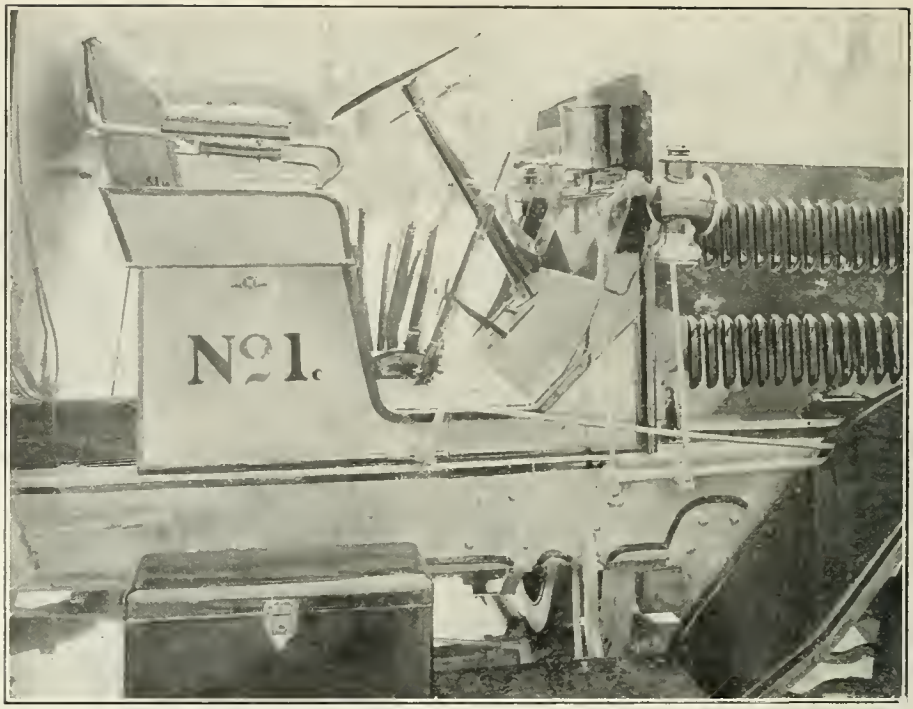
The city of Pueblo, Colo., has purchased from the Kissel Motor Car Company a motor-driven street sprinkler and flusher that is, in many particulars, quite different from anything of the kind heretofore produced.

The tank is mounted on a six-ton chassis, the largest made by the Kissel company. The car, loaded and fully equipped, weighs about twelve tons and carries 1,500 gallons of water. It is designed to do away with at least fourteen horse-drawn rigs. A letter regarding the tests made of this vehicle says, among other things:

"The water pump, when used for flushing, requires about 8 horsepower at 50



KISSEL *street sprinkler and flusher in use in Pueblo, Colorado. Sprinkler heads in front; flushing nozzles in rear of front wheels.*



LEVERS *of Kissel street sprinkler and flusher, for controlling motor, pump, each sprinkler head and each flushing nozzle.*

pounds pressure, hut we find the motor picks up this load, together with that of the car, in a surprisingly easy manner. We are very much pleased with the rig as a whole."

Power Traction Trench Tamper

The P. and H. trench tamper is not only an efficient tamper of material to fill excavations, but is equally efficient as a cutter of asphalt and a breaker of concrete.

Some of the features of the machine are the following:

1. The wheels are carried on stub axles of steel that may be raised or lowered 5 inches, on either side, from the center of the upright members of the main frame to which they are attached. This device makes it possible to keep the machine level tho one wheel be on ground 10 inches higher than the other.

2. The axles of the tamper are carried out far enough to allow of widening the wheel tread 12 inches on either side, 24 inches in all. The minimum tread is 4 feet 8 inches and the maximum is 6 feet 8 inches. It is not necessary to move both wheels unless desired, as it may be necessary to leave one wheel close to the trench on account of narrow berm. This may be regulated to suit conditions and the wheels may be placed at any point within the range of adjustment.

3. The tamping head moves across the machine on a solid steel runway provided for it. The weight of the entire machine is carried on 6-inch rollers and is evenly distributed. The tamping head is 12 inches wide and has a maximum cross travel of 20 inches, enabling it to actually cover 32 inches of trench. Since it is not necessary to tamp closer than 4 inches to the wall of the trench in most cases, the machine will handle a 40-inch trench. The tamping ram is operated by means of a large segment brought in friction contact with the hardwood ram by spring pressure on a large pulley on the opposite side of the ram. This segment is caused to revolve from 50 to 60 times per minute and, of course, causes a stroke of the ram at every revolution. This stroke has an average of 22 inches travel, and, as the ram and tamping head together weigh 150 pounds, a thoro packing of the earth results. When

it is considered in comparison with hand labor the machine shows its worth very forcibly. It is pointed out that a good laborer with even a 15-pound tamper will not average more than 20 strokes a minute and will hardly ever lift the hammer more than 9 or 10 inches, as compared with the machine's 150-pound ram, 22-inch stroke, 60 a minute and "do it all the time."

4. The traction tamper moves entirely under its own power. The engine is throttle-governed with jump-spark ignition and is water-cooled. A speed of 1 1-3 miles per hour is provided for road traveling, tho this may be varied by changing the engine governor. A feeding speed, ranging approximately from 10 to 25 feet per minute, is provided to furnish a continuous slow movement forward when at work. A suitable reverse is provided for convenient movement of the machine.

It is claimed that the machine will do the work of 8 men in tamping, on the average; of 7 men in cutting asphalt, and of 3 men in breaking concrete. Its average speed of work is 1,080 square feet of tamping per hour, 145 linear feet of asphalt cut or 54.6 square feet of concrete broken up. It operates with one man.

Pawling and Harnischfeger Company, Milwaukee, Wis., are the manufacturers of this labor-saving and efficient machine and will give full detail of actual results and references to jobs on which it has been used.

Gypsum as a Fireproof Material

A very interesting and valuable treatise on "Gypsum as a Fireproof Material," by H. G. Perring, Assoc. M. Am. Soc. C. E., is published by the United States Gypsum Co., 205 West Monroe street, Chicago, Ill., and can be had for the asking. The conclusions of the article, aside from the examples of actual service, may be stated briefly in the following paragraphs:

Analyzing the special features of Gypsum plaster in general, which make the material desirable as fireproofing, we find the following points:

1st. Low heat conductivity is an essential point. In partitions heat is not conducted thru to set fire to furnishings, etc., on the opposite side. In the protection of structural steel work the steel is protected from the weakening action of heat. Many fires attain a temperature of 2000 degrees F. At 1700 degrees F. a steel column can only bear its own weight. The heat penetrates the plaster at such a slow rate that in the fires of ordinary duration the metal would hardly get warm.

2nd. Tests and experiments have failed to indicate any appreciable expansion of plaster under heat action. An inherent quality of all other forms of fireproofing is high expansion, resulting in a tendency of the fireproofing to wreck itself either by buckling, or, in the case of material of tile shape, the cracking off of the tile face. This destructive element does not enter into Gypsum fireproofing.

3rd. Materials of a nature that expand under heat readily contract when water is applied to the heated surface. This contraction is often so severe as to cause the bursting of the material. Plaster partially recalcines under high heat action and the subsequent application of water removes this recalcined portion. Plaster being a fairly soft material is eroded to some extent by water at a high pressure, but plaster fireproofing generally will withstand severe water application, there being no indication of the bursting so common in other materials.

4th. Any material to be used for fireproofing must not burn or support combustion. Plaster is incombustible.

5th. Lightness is essential in fireproofing, as the fireproofing at best is dead load on a building and plays no part in the support of the structure. Plaster is the lightest practical fireproofing material. Its use reduces the load on structural sections and in case of fire makes the building less liable to collapse.

6th. Plaster fireproofing has sufficient strength for use in partitions, column covering, etc., and in fires will stand up reliably against the impact of fire streams.

7th. Plaster is adaptable to any form of construction. Where used in slabs they are readily sawed or cut to fit any desired location and the use of the material in the plastic state will cover any possible condition of construction.

8th. The desirable fireproofing material is one that combines all the fireproofing features with low cost.

It is only by such a combination that the building of fireproof buildings will be encouraged. Plaster is in itself low of cost. Because of its lightness it reduces the load on a building, thus allowing a lessened amount of structural material.

Its lightness makes it more easily handled. Its adaptability, the ease with which it is sawed, etc., makes the construction of fireproofing easy. Trim can be nailed to plaster fireproofing without the use of wood blocks or grounds, saving the cost thereof and omitting combustible material from the building. Plaster blocks or boards are true and even and reduce the cost of plastering to a minimum.

Sidewalk Science

A booklet on sidewalk, curb and gutter construction is issued by the Hotchkiss Lock Metal Form Co., of Binghamton, N. Y., which should be in the hands of every engineer or contractor interested in the construction of such improvements, whether they are users of the metal forms or not, because it so thoroly demonstrates the principles of right construction of concrete work, particularly in walks and curbs. The company will send the booklet, "Sidewalk Science," on request. It is worth sending for also for the many novel ideas in the use of forms for the special constructions so common in connection with private walks, steps, sidewalk, blocks, curb and the like with which it is filled.

An Electric Calculating Machine for Engineer and Contractor

Among the inventions of the past few years there is no one which offers more relief from mere mental drudgery in engineering work than the electric calculating machine. This electric calculating machine puts keys at the beck of the finger tips which enable the engineer to instantly solve all kinds of problems in multiplication, division, addition, and subtraction.

In the accompanying illustration of the Ensign electric calculating machine is shown the working face of the Ensign machine, the motor and drive and tubular stand on which they rest being the necessary but uninteresting part of the detail of operation.

This machine handles multiplication, division, addition and subtraction with amazing rapidity, taking all work up to and including 9 figures by 7 figures and giving the complete result to 20 places.

It operates so rapidly that it will take care of the work of the most speedy operator, and by the use of a series of proof dials, the work may be checked at the time the calculation is made, thus eliminating the need for a second checking of even original calculations.

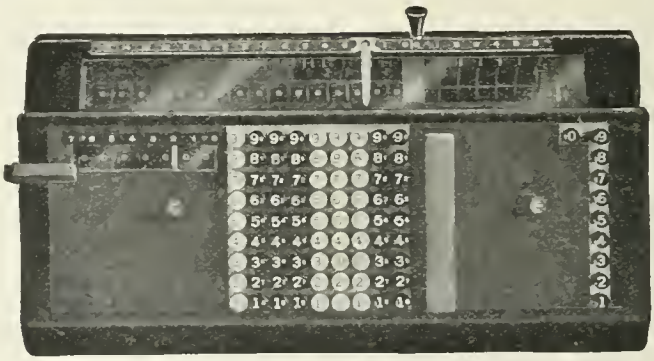
The nine rows of keys are adding keys, addition being performed by merely striking the proper keys—which remain depressed—then touching the adding bar at the right of the keys, which instantly releases the keys and registers the amount or adds it in—the result appearing in the result meter dials, just above the adding keys.

The keyboard is flexible so that errors may be instantly corrected by merely striking the proper keys, as the amounts are not calculated in until the adding bar is struck, in addition, or the proper key in the multiplying keyboard, for multiplication and division work.

The single row of keys at the right is the multiplying keyboard. To multiply you merely depress the proper keys in the adding section representing, say 467, 892, 375, and then depress the proper keys for the multiplier in the multiplying keyboard, say 6, 731, 837—beginning with the right hand figure, the same as if multiplying with pencil and paper—and the moment the last figure of the multiplier is registered in the multiplying keyboard, the result or product (in this case it would be) will appear in the result meter, and the figures of the multiplier (6, 731, 837) will appear in the proof dials at the left of the adding keyboard. The keys previously depressed in the adding keyboard remain depressed. Thus the operator may instantly check back the work to see that the amounts multiplied, or divided, have been properly recorded, and thus know that the work is absolutely correct.

In division work, the quotient appears at the left side in the result meter dials and the proof of the quotient in the proof meter dials.

This feature of proof and ability to in-



KEYBOARD OF ELECTRIC CALCULATING MACHINE.

stantly check all operations is a most important feature, as this enables a user of this machine to save all cost for again checking the work, which in many cases will split the cost of handling all figuring right in two, especially in cost accounting, pay roll work, tabular engineering figuring, estimating, etc., to say nothing of the great speed of the machine, which saves three-fourths to four-fifths of the time over pencil and paper calculation. When the time of a valuable employee or an engineer is involved, the cost of this machine may be easily saved in a very short time.

The "C" key (constant button) when depressed, will lock any constant figure in the adding section, so that repeated multiplications may be made, where the multiplicand is the same for a number of multiplications, by simply pressing the keys in a multiplying keyboard, which represent the figures of the different multipliers.

The Ensign electric calculating machines are all electrically operated, but have automatic control, the motor being instantly cut out the minute the operation is performed, so that little current is consumed and the motor need never be left with current turned thru it.

J. P. Sharpe, western sales manager, 72 West Adams street, Chicago, Ill., will give any further detail desired.

Specifications for Standard Brick Pavements

The National Paving Brick Manufacturers' Association, thru a committee of practical and experienced civil engineers, road builders and manufacturers of paving brick, all of whom have had many years of experience with the building of brick roads and pavements and the manufacture of paving brick, have prepared and published "Specifications for the Construction of Vitrified Brick Street Pavements and Vitrified Brick Highways." In this effort they have endeavored to give the best economical value in the use of paving brick possible; durability, satisfaction in use, ease of traction and a maximum of sanitation.

The association stands ready to render such personal assistance thru its engineering department as may be desired, to the end that the highest and most perfect type of pavement possible will result.

They have made it easy for engineers to inspect good work and to see what results from poor work. They firmly believe in the principles of their manner and method of brick road construction and great public welfare and advantage will follow their use and adoption.

Copies of the latest edition of these specifications will be sent on request by Will P. Blair, secretary of the association, B. L. E. building, Cleveland, O.

Medusa Waterproofing

Medusa waterproofing is a dry white powder and consists of fatty acids, chemically combined with lime. Owing to its extreme fineness it may easily be perfectly mixed with cement in the necessary proportions.

Medusa has now been on the market several years, is the original concrete waterproofing, patented in 1907, and has been used in every part of the world under every condition and in every character of construction in which Portland cement is used.

To render cement work impervious to water a small quantity of the waterproofing is thoroly mixed with the dry cement before the addition of sand and water. For most purposes from 1 to 2 per cent. of the weight of cement used will be found sufficient. This is equivalent to from 4 to 8 pounds of waterproofing 1 barrel of cement. The precise amount to be used must be left to the experience of the user and depends upon the proportion of sand etc., employed, and on the kind of work to be done.

Thoro mixing is of the utmost importance.

Medusa waterproofing is not soluble, therefore after mixing it dry with dry cement, add sand and mix thoroly; then add water slowly until desired consistency is secured. This will prevent the waterproofing being washed out of the mixture.

It is well known that comparatively poor mixtures of cement, sand and gravel or stone are abundantly strong for most purposes. The drawback to these poor mixtures is their porosity, which causes them to absorb water like a sponge. So-called water-tight mortar may be made by using a large proportion of cement or cement and lime, at great cost. We have found that cement with 1 per cent. of Medusa waterproofing, with five parts sand, gives a more impervious mortar than ordinary untreated cement with two parts sand.

Medusa waterproofing does not affect the color, strength, setting or hardening qualities of concrete and when used in proper proportions it will make any concrete work impervious to water and prevent discoloration from rain.

Medusa waterproofing prevents the white efflorescence which so often renders cement work unsightly; also prevents the appearance of hair-cracks on the surface.

Its use in facing mixture gives satisfactory results.

For mortar, plaster and stucco, use 1½ to 2 per cent. mixture; this means 1½ to 2 pounds waterproofing to each sack of cement or 6 to 8 pounds to a barrel. Mix thoroly while dry. This percentage in a mix of 1 part cement and 2 parts sand is recommended for stucco work as well as plaster for waterproofing cellars, reservoirs, water-tanks, cisterns, foundations, etc. For cement floors and roofs it is only necessary to use a 2 per cent. mixture in top or finishing coat.

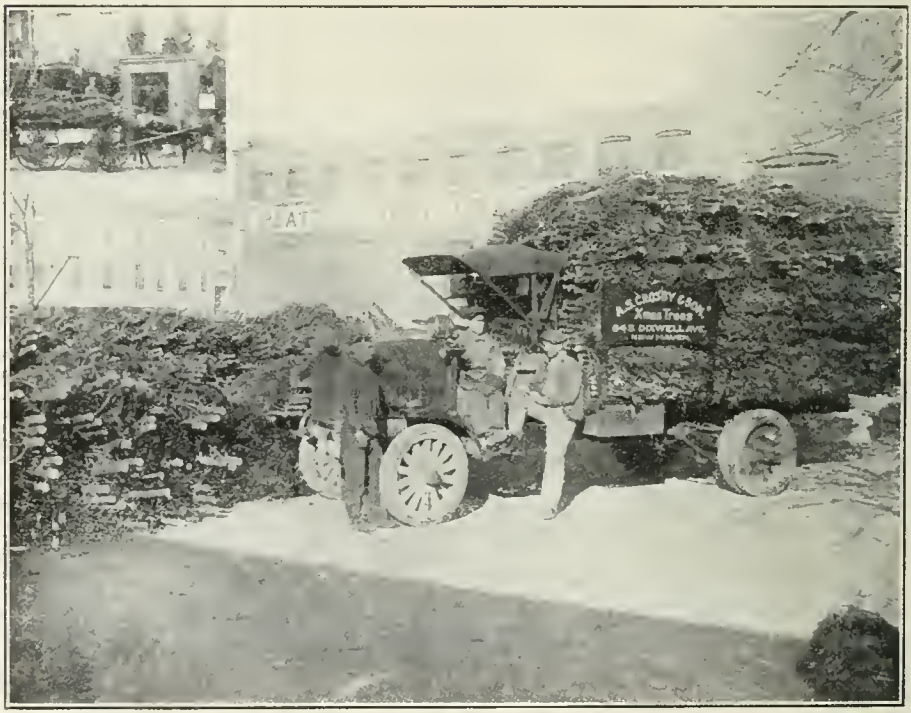
For a wash use 1½ per cent. mixture; this means 1½ pounds waterproofing to each sack of cement, or 6 pounds to a barrel. Mix thoroly while dry. Put a portion of the mixture in a pail, add water slowly and sufficient to make a paint of the consistency of cream. Keep agitated with a stick while in use. The surface must be thoroughly wetted, and the wash applied evenly with a brush. The coating must be thin, or hair-cracks are likely to develop. This mixture will give a waterproof surface.

A new booklet issued by the Sandusky Portland Cement Co. goes into much detail as to the uses of Medusa waterproofing and the success met with by many users.

Auto Truck for Oil Delivery

Some interesting facts regarding the distribution of oil by means of a motor truck comes from the Morlite Oil Company, of Warrensburg, Mo. This company has a 1½-ton KisselKar truck, fitted with a tank of 500 gallons capacity, which is used for the wholesale delivery of kerosene and gasoline to stores thruout the country. There are fourteen of these stores situated from 6 to 20 miles apart, each of which is served once a week. In addition, the truck delivers to twenty-two stores in Warrensburg, these deliveries being made daily.

The delivery equipment of the Morlite company consists of this one KisselKar truck with a crew of driver and helper, while that of a competing firm comprises two-horse teams operated by three men. The horse teams together make on an average of 25 miles per day, working from early morning until late at night and sometimes visiting but one of the country stores. The truck, on the other hand, makes the city deliveries first and then delivers to six or seven of the country stores, returning to the city by four



KISSEL TRUCK *making Christmas tree deliveries in New Haven, Conn.*

five in the afternoon, after covering from 30 to 50 miles. The owners state that the average monthly consumption of gasoline and lubricating oil, respectively, is 100 gallons and 5 gallons.

Specifications for Bituminous Road Binder

The following specifications followed carefully will insure an excellent material for bituminous road construction:

A bituminous road binder in order to be eligible for use under these specifications for the construction of a bituminous surface, of the type herein called for, must comply in all respects with the following practical and established tests for the purpose hereinafter stated.

The bid of each contractor must specifically state the brand of bituminous road binder which he proposes to use. He must give the name, nature and chemical analysis of the material to be used, and where and by whom produced. His bid must be accompanied with a sample of at least one pound of it, properly marked and identified. Bids which do not comply with this requirement will be rejected as irregular.

Test 1—Ductility: In order to demonstrate the cementitious or adhesive character of the bituminous road binder, such binder as used must have a ductility of not less than 50 centimeters at 77 degrees F., according to the District of Columbia standard.

Test 2—Specific Gravity: In order to demonstrate that the bituminous road binder is of an asphaltic and cementitious character, as distinguished from an oily and non-cementitious character, and to preserve the proper balance between its adhesive and cohesive qualities, the specific gravity shall be not less than 1.04 at 77 degrees F.

Test 3—Paraffine Scale: In order to further demonstrate that the bituminous road binder is of an asphaltic and cementitious character, and to insure against the excessive use of non-cementitious materials produced from oils having a paraffine base, the bituminous road binder must not contain more than one-half of one per cent. of paraffine scale, as determined by the Holde method.

Test 4—Penetration: In order to demonstrate that the bituminous road binder proposed to be used is of the proper degree of consistency, it must, when tested for five seconds at 77 degrees F. with a No. 2 needle weighted with 100 grams, have a penetration of at least 12 millimeters and not more than 15 millimeters.

Test 5—Volatilization: In order to demonstrate that the bituminous road binder is of a sufficient stability to insure against loss of consistency and cementitiousness upon being subjected to working heat, it shall meet the following test: When 50 grams of the bituminous road binder are heated in a dish 2¼ inches in diameter for seven hours at 325 degrees F., the loss shall not exceed 3 per cent. and the penetration and ductility of the residue shall not be reduced more than 50 per cent. from its original consistency and ductility.

Test 6—Viscosity: In order to demonstrate that the bituminous road binder is of the proper degree of viscosity, and to demonstrate that such binder has a sufficiently low melting point to insure its penetration to a sufficient depth when poured upon or over the cold stone (or to insure its mixing properly and conveniently with the mineral aggregate), it shall have a float test of not more than five minutes at 150 degrees F., as determined by the float test apparatus manufactured by Howard & Morse, Brooklyn, N. Y.

Test 7—Purity of the Bituminous Road Binder: In order to demonstrate the percentage of bitumen in the bituminous road binder, and in order to regulate the uniformity of this material, it shall be soluble to the extent of at least 95 per cent. in carbon disulphide.

Test 8—Flash Point: In order to insure safety of operation the bituminous road binder must show a flash point (New York State closed oil tester) of not less than 325 degrees F.

Test 9—Durability: In order to demonstrate that the bituminous road binder is sufficiently stable and durable, it must not suffer a reduction in ductility of more than 10 per cent. from its original ductility after it has been incorporated in the paving mixture and extracted therefrom with purified carbon disulphide.

Test 10—Standard: Any bituminous road binder to be eligible for use under these specifications must be in all respects equal in quality to the standard bituminous road binder produced from refined Bermudez Lake asphalt; but whether the binder used is produced from refined Bermudez Lake asphalt or otherwise, it shall not be considered as complying with these specifications unless it complies with each and all of the tests hereinabove specified.

Tire Abuses

"Overloading and overspeeding trucks are prime causes of premature solid tire breakdowns—there are increased expense for the truck user, "time out" for frequent renewals, controversies in regard to adjustments, premature discard of tires

and dissatisfaction with trucks." Mr. S. V. Norton, manager of truck tire sales for the B. F. Goodrich Company, thus sums up his paper on "The Causes and Effects of Overloading and Overspeeding in the Truck Tire Field," before the Motor Truck Club of America.

"The immediate effect of overloading and overspeeding," said Mr. Norton, "is premature tire destruction due to a greater liability to cuts, base separation from excess loads, friction and strain of skidding, weakening of a dual tire if the mate is injured, and overheating with constant disintegration of the rubber. Truck owners naturally desire to get as much work as possible out of their trucks and they may be led to overspeed them. If a truck owner wants to make 'intensive deliveries' he must pay for overspeeding in his tire bills. However, the trucks are often overspeeded without the owner's knowledge, owing to the driver's desire to make a good showing either with the loaded truck or by returning from a trip in quick time. Often drivers speed merely for the sake of the spare time gained

"Overspeeding as a rule is entirely unnecessary, as it need not be due to the absence of a governor or to the power of the truck. Down grades, easy riding, lack of obstacles and extra speed in car tracks all lead drivers to overspeed.

"The causes of overloading are usually due to improper or disproportioned tire equipment or to excessive or poorly arranged loads. Trucks are often overloaded owning to the ignorance of the owner as to what his trucks can safely carry. Loads may be placed too far back or forward on the body of the truck, even tho the loads are within the limits of the tire schedule of carrying capacities.

"Tire equipment may be disproportioned; tires may be too large on one axle and too small on the other, or the body may be too large for the tires. A large body may be allowed to pass unquestioned by a truck agent who is anxious to clinch a sale. This danger may not have been fully explained by the truck salesman when the truck was purchased or the owner may be too occupied to know what is going on. The ignorance or indifference of the driver may also be causes of overloaded trucks.

"One effect of the widespread abuse of tires thru overspeeding and overloading is a stimulation for better tires to meet the present conditions. The defects caused by overloading or overspeeding are usually brought home to the time manufacturer. However, tire makers are meeting conditions by educating all concerned in the proper care of tires, by adopting more rational guarantees, and by improving the tires themselves to meet every possible condition of service."

The B. F. Goodrich Company, for instance, has prepared a series of folders which deal at length with the common causes of tire abuses and remedies for such abuses. These folders, which will be sent to any truck user upon request, cover the following causes of truck tire breakdowns ':'Neglected Cuts," "Overloading," "Running in Car Tracks," "Bad Roads," "Skidding,' "' Anti-Skid Devices," "Wheels Out of Alinement,' 'and "Overspeeding." These valuable pamphlets are distributed from the Goodrich branches in all principal cities, or from the factory at Akron, Ohio.

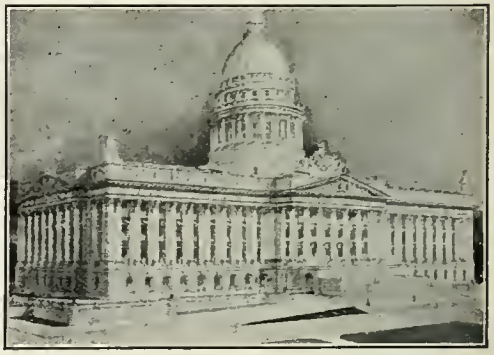
Johns-Manville Co. Gets Big Pipe Covering Contract

The pipe insulation contract for the new Utah state capitol at Salt Lake City, for which R. K. A. Kletting is the architect, and Jas. C. Stewart Co. are the contractors, was recently awarded to the H. W. Johns-Manville Company.

The high pressure pipes will be covered with J-M asbestos-sponge felted pipe covering, a product made up of laminations of felt composed of asbestos and finely ground sponge. The materials being naturally cellular, they form the basis for the claim that this covering confines more "dead air" cells than any other covering—and therefore possesses higher heat-insulating value.

The heating pipes will be covered with J-M asbestocel pipe covering, which is built up on the arch principle. Sealed air channels run around the pipe, instead of parallel with it, thus preventing the circulation of air and consequent heat radiation.

UTAH STATE CAPITOL *building in which heat-insulation by J-M system is to be installed.*



MUNICIPAL ENGINEERING

The World's Leading Municipal Publication.

MARKET STREET, WILMINGTON, DEL. BITULITHIC PAVEMENT WITH STONE BETWEEN STREET RAILWAY TRACKS.

VOL. XLVIII. FEBRUARY, 1915. NO. 2.

Engineers are the votaries of an art which has for its object the furthering of things and methods that serve for the use and convenience of man. They should make that object the aim of the direct tendency of their work and the criterion of its fitness for the exercise of their energies.—Clemens Herschel.

Published by

Engineering Publishing Co.
INDIANAPOLIS, IND.

New York Office:
1127 World Bldg.
GEO. H. CLINGAN,
Eastern Mgr.

Chicago Office:
1634 Marquette Bldg.
E. D. POWELL,
Western Mgr.

Entered at Postoffice, Indianapolis, as Second-Class Matter.

A. P. Fox, President. **C. C. Brown, Editor.** **C. S. Sale, Gen'l Mgr.**

Subscriptioo Price in U. S. and Possessions, Cuba and Mexico, $2.00. Cacada, $2.40. Foreign, $2.75.

Changes of address, subscriptions, remittances and editorial matter should be addressed to MUNICIPAL ENGINEERING, Indianapolis, Ind.

STREET LIGHTING PRACTICE

WITH INCANDESCENT LAMPS

By G. H. Stickney, Harrison, N. J.

This carefully prepared discussion of the use of modern incandescent lamps in street lighting is by an expert who is familiar with all the problems arising in connection with the installation of a system of electric street lighting. It is part of a paper prepared for the American Society of Municipal Improvements and lays down the principles which have been developed, the illustrations giving examples of some details of installations.

IN the lighting of a modern American city, one encounters a range of practice varying, step by step, from the dim lighting in the outlying districts to the brilliant lighting of the main central thorofares. This typifies, in a way, the historical progress of the art from the time the best street lighting consisted merely of beacons to guide the travelers, up to the present standard of ornamental street lighting. Nor has the practice shown an indication of having reached an ultimate standard. On the contrary, the rate of advance at the present time seems to be more rapid than ever before. Never has the value of good street illumination been so highly appreciated, while the recent improvements in illuminants, tending toward the economical production and utilization of light, seem likely to result in raising the standard rather than in reducing the cost to any great extent.

The history of street lighting indicates that better lighting follows closely on the availability of improved illuminants. As an example of this, we may note the advances which followed when the open arc became available about 1878; the enclosed arc about 1895; the luminous arc about 1904, and the tungsten filament incandescent lamp about 1907.

Purpose.—While the purpose of street lighting has been discussed frequently, it is desirable that we have clearly in mind the purpose of the illumination.

For ordinary or utility street lighting, the main purpose is to permit the traveler to pursue his way with safety and convenience. In outlying roads, the lighting may serve merely as a guide to enable the traveler to keep on the road. In city lighting, it is important that one be enabled to avoid irregularities in the street, as well as collision with others. Where the density of traffic is greater, the danger of collision is correspondingly increased, and hence clear and quick vision is more necessary.

Nowadays, thanks to the extension of street lighting, we hear less about the value of street lighting as a protection against persons of evil intent—robbers, highwaymen, etc. Yet we must not overlook the importance of street lighting in the preservation of peace. The extension of good lighting into sections of a city which are subject to disorder, is one of the most effective means of eliminating the evil.

Beyond all this, however, there is another purpose for street lighting, which has developed rapidly in the past decade, and has demanded for certain sections of a city an intensity of illumination which often considerably exceeds that required for safety. The new element of such lighting is the endeavor often made, at considerable expenditure, to render the street more pleasing and attractive. This is the motive of the so-called ornamental or whiteway lighting.

Owing to the influence of the ornamental lighting, this purpose is also now felt to a greater or less degree in ordinary street lighting.

Illumination Effects.—The practice as regards illumination effects may be considered from several distinct standpoints. It is useful to classify the practice, however, with regard to the extent and nature of the illumination, as follows:

(1) Beacon lighting;

(2) Uneven illumination;

(3) Even illumination.

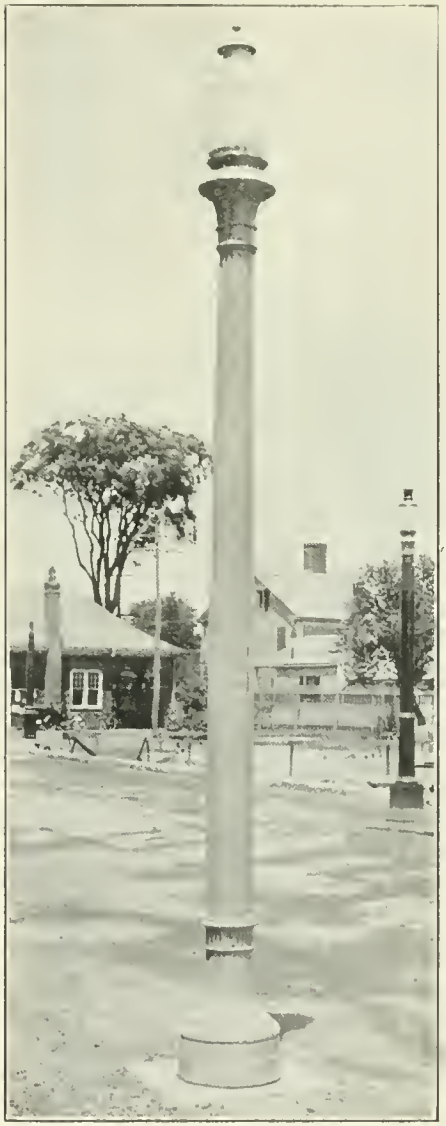
Beacon Lighting.—This character of lighting has already been mentioned. Practically no illumination falls on the roadway, the low intensity lights serving, by their location, to indicate the course of the road, much as a lighthouse and beacons at sea guide the navigators. Such lighting is, of course, inadequate for city streets, but for rural roads, where questions of cost may prohibit the adoption of a higher standard, such lighting will add considerably to the safety of travel; and for such conditions the extension of even this low intensity lighting will be beneficial in developing the country.

Uneven Illumination.—This refers to the practice often observed where areas of streets, near the lamps, are illuminated to a fair intensity, while the intervening sections are but slightly illuminated, and may, in contrast to the illuminated portions, appear to be in absolute darkness. The practice originated thru the early use of arc lamps, especially the open carbon arcs, which, for economy, were spaced at wide intervals—usually at street intersections. At first thought this practice may seem to be entirely unjustified, except on account of the peculiarities of the illuminants, which, in the case mentioned, were inherently of relatively high power.

However, there has been much discussion and difference of opinion on this subject on the part of students of street lighting practice. For certain conditions there seems to be more reason for the practice than would appear on superficial consideration.

Where the intensity of street illumination is very low, large objects, vehicles, etc., are seen in silhouette—usually as dark outlines against an illuminated street surface. Under such conditions experience has shown that such objects can be seen at a much greater distance by the uneven illumination, than if the same total amount of light were evenly distributed.

ORNAMENTAL POLE *top equipment for high-power series Mazda lamps. Three slightly different designs of poles are shown, of various degrees of attractiveness by day and by night.*



Since high power units, widely spaced, cost less per mile of street than low power units at correspondingly narrower intervals, it often happens, where the cost of street lighting must be minimized, that this is the most practicable method of lighting. By locating the light sources over the street at points of street intersections, where the greatest danger of collisions exist, this method is likely to meet the needs of the drivers of vehicles, especially swift-moving automobiles, altho the glare may be objectionable.

The weakest point of this method is that it does not serve the pedestrian on the sidewalk advantageously. Especially where there is dense foliage, or streets are curved and narrow, it is not effective. Where there are irregular intersections of streets, some crossings cannot be properly illuminated without a narrower spacing of lights which may offset the principal advantage, namely, low cost.

Even Lighting.—We commonly refer to a street as evenly lighted if the intensities on the surface do not vary more than, say 10 or 15 to 1. With such lighting the street appears to the ordinary observer to have an even illumination.

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¶ LOW INTENSITY OF LIGHT, *with lamps closer together, produces better appearance of street and more even illumination, and is the more satisfactory for the pedestrian.*

The appearance of the street is very greatly improved with such lighting in contrast to the spotted illumination discussed previously. With higher intensity illumination, it is possible to see better than with corresponding uneven illumination; moreover, the cost is not likely to be much greater.

Classes of Streets.—While street lighting, as already mentioned, is graded by steps from the business center toward the suburbs, it is evident that it is not practicable to have too many steps, lest the lighting system become too complicated for economical operation. The variation usually should not be uniform in all directions, but should depend upon the character and importance of the streets, amount of traffic, etc.

This problem can best be studied by classifying the streets or sections of streets in a small number of groups having similar requirements; and reviewing their needs. Such classification would, of course, vary for different types of cities; for example, it is apparent that street lighting in Manhattan Boro would not typically represent an average American city; and that manufacturing cities would not exactly correspond to residential cities. However, our purposes can be sufficiently served by the following general classification:

(1) Principal business streets;
(2) Ordinary business streets and thorofares;
(3) Residential streets and parkways;
(4) Outlying streets, newly developed sections;
(5) Rural streets and interurban highways.

Whiteway lighting of the principal business streets demands not only the highest intensity of illumination, but diffusion and evenness. The tendency is to provide the maximum illumination opposite the buildings rather than at the street intersections. This is especially true when the lighting is promoted by merchants for advertising purposes. It is, however, good practice, since the illumination on the building front plays an important part in rendering the street attractive; while the illumination at the corners is almost certain to be sufficient for all purposes. Further, since most of this class of lighting employs ornamental lamp posts along the curb, it is often desirable to avoid placing lights at the street corner, as the glare from such a lamp in the eyes of a vehicle driver, who is about to turn a corner and wishes to see beyond, is likely to be more objectionable than the increased light is advantageous.

That the illumination of the building fronts contributes considerably to the cheerful appearance of the street, is evident from the gloomy appearance when the light is cut off from the buildings, even tho the surface of the street is well lighted.

Ordinary business streets, thorofares and residential streets, in which houses

are in blocks and foliage absent, should differ in treatment from the principal streets only in the degree of intensity and ornamental effect. The lighting units should be so arranged as to provide ample intensity at street intersections.

In the usual residence streets and parkways, where foliage abounds and the border of building fronts is absent, upward lighting is of little value. The degree of illumination required depends upon the amount of travel. The decorative value of the fixtures should, as far as practicable, correspond to the character of the street. As a rule, lights must be placed low to avoid tree shadows. Hence, a fairly frequent spacing with low power lamps is required. Where foliage be absent, wider spacing and larger units are practicable and often more economical.

For outlying and newly developed sections, which are likely to develop as residence sections, it is well to provide a spacing corresponding to the residential sections, securing economy by the use of low power lamps and arranging for effective distribution, even if some glare is present. This will permit changing readily as the demand for better illumination develops.

As we have already noted, the physical character of the street has a very decided bearing in determining the design of the lighting system. The width of the street should have a considerable influence in determining the height, spacing and arrangement of lighting units.

A factor which is often overlooked is the color of the street surface. A dark surface demands much more light for effective seeing than a light one. The oiling of streets, which were formerly a light colored macadam, has been a frequent source of complaint of the street lighting, tho the cause of the deficiency has often been overlooked. It can hardly be expected that streets will always be finished to suit the street lighting, but since the color has so decided an effect on the illumination, the lighting should be considered in this connection.

The variety of factors entering into the problems of street lighting render it necessary to make many compromises. The desirability of unity of design thruout a city, should not be overlooked, especially in the lighting of a long thorofare, which may extend from a business center to the outskirts. In such a case it may be necessary to sacrifice the peculiar requirements of a particular section to the production of an effective whole. It is usually practicable to grade the illumination by using lower power units of similar design, or by using wider spacing, away from the center. In case more than one light source per pole is provided, it is some times advisable to secure this result by varying the number of lights per pole.

Arrangements of Lights.—Quite a variety of arrangements of lighting units is in vogue, but the recent installations show a marked tendency toward the use of poles along the curb line, with lamps upright at the top of the pole, or hung

BALL GLOBE *pole top equipment for low-power Mazda lamp used in Rochester, N. Y., with concrete pole.*

pendent at the end of a short arm or ornamental neck. Especially in those cases where attractive appearance is considered important, the pole top unit predominates. See Figures 7, 9 and 10.

In the early installations of large units, it was the common practice to suspend the lamp over the middle of the street. This arrangement undoubtedly is generally the one which provides for the most economical distribution of light and is advantageous for producing the silhouette effect. On the other hand, this position, unless the lamps are hung very high, gives maximum glare in the eyes of a driver; while the overhead construction is rather unsightly in the day time. Long arm suspensions on curb poles are frequently advantageous, especially where foliage is present, but here again glare at night and unsightly appearance in day time, are likely to be encountered.

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¶ CLUSTER LIGHTS, *recently so popular, are wasteful of light because of ineffective distribution. Large size tungsten lamps have made simpler and more effective designs possible.*

When tungsten filament incandescent lamps were available only in small sizes, it became the practice, especially in ornamental lighting, to group four or five, and sometimes more, lamps in individual round globes at the pole top. The effect, particularly of the individual pole, was very attractive. Probably no other type of lighting units ever enjoyed as wide popularity or secured as rapid application. It was well known among engineers that, on account of the loss of light by ineffective distribution, as well as the interference of absorbing surfaces, this scheme of lighting was wasteful of light. When larger size tungsten lamps became available, with their higher efficiency and lower maintenance cost, the relative extravagance of the cluster lighting became more apparent. As a rule, the one or two light units, while individually less striking in appearance than the four or five light cluster, make a better perspective appearance of the street, and are more efficient, so that today cluster lighting is gradually giving way to these simpler designs.

Pendent units can be made to present a neat appearance in the street, and have the advantage of usually providing a more economical distribution of light, especially in the residence districts, where the upward light can be cut off by reflectors and utilized. See two cuts on following pages.

There is considerable difference of opinion as to the relative advantages of placing poles opposite, staggering alternately from one side of the street to the other, and arranging them along one side of the street only. The opposite arrangement makes the best appearance and, on wide streets, gives fairly even lighting with proper spacing.

On narrower streets, especially with wide spacing, the staggered arrangement gives a better distribution of illumination. With very low intensity lighting, particularly on curved roadways, as in parks, the staggered arrangement should be avoided; it has some times led drivers to run off the roadway, and where dangerous obstructions occurred at the roadside, this has resulted in serious accidents.

The arrangement of poles on one side of a narrow street is often very effective and economical, and is especially applicable to the lighting of parkways, and suburban or residence streets. This arrangement is not likely, however, to meet with favor in commercial streets, as it tends to draw pedestrians to one side of the street, to the disadvantage of stores on the other side.

On boulevards and wide streets, having grass plots in the center, it is often advantageous to locate lamp poles down the center, or, in some cases, to combine this arrangement in various ways, with lines along the curbs.

In some cities small incandescent lamps have been arranged in arches or festoons, either across the street or along the curb. Very few permanent installations on this order have been made. The lighting may be quite evenly distributed over the street surface. The general effect, however, is more of a gala or festive one, more suitable for a celebration or other temporary

occasion, rather than for permanent lighting.

Height and Spacing of Lamps.—It is impracticable to give an accurate rule for determining height and spacing, but the following comments, based on the practice, should be helpful.

The spacing of lamps differs for various arrangements of poles, as well as for the power of unit and intensity of the illumination required. The height and spacing are interdependent and each should be determined with relation to the other, allowance being made for the characteristic distribution of light from the lamp employed.

Too frequent spacing of lamps should be avoided to prevent cluttering the street with poles. This, however, is an unusual fault, since economy usually tends to dictate too wide a spacing for the most effective lighting. In business districts, the spacing between pairs of opposite poles, or along the street between staggered poles, generally runs between 60 and 120 feet. In residence districts the spacing is a little wider, say, 100 to 200 feet. In older installations, spacing as wide as 400 feet is not uncommon; but with the range of sizes of lighting units now available, it is seldom good practice to space lamps further than indicated above, except for the so-called beacon lighting. The tendency is toward narrower spacing, using smaller power lamps, if necessary, to secure economy. Except as mentioned elsewhere with regard to ornamental street lighting, it is advantageous to provide at least one lamp at each street intersection, and the spacing should be planned with this in view. Where blocks along a street vary in length, spacing for different blocks can be slightly modified from the average, to equalize the intervals for each block.

In planning locations, it is some times found advantageous to indicate lights by means of small weights on a plan of the section to be lighted, and thus trying the different possible arrangements and spacings until the best one is obtained.

In grading the ligbting for a city, comparisons can best be made in flux of light per unit of street length or area. A few years ago when lamp efficiencies were more uniform, such comparisons were often made In watts per running foot of street, but at the present time mean spherical candle power per foot, or lu-

TWO-LIGHT *ornamental pole with pendent fixtures for Mazda lamps, in use in Hartford, Conn., presents an attractive appearance and is especially suitable for the conditions. Note the distribution of the poles down the street within the view.*

mens per foot, will be more reliable. A more accurate measure, especially for high intensity lighting, would be in terms of the average foot candles of intensity on the street surface. This involves a more laborious calculation, based on particular arrangement of units and reference to photometric curves, and is not ordinarily justified.

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¶ THE NEW TESTS *are determining brightness of the illuminated surface as well as intensity of illumination, and will make it easier to fit the lamps to the kind of work to be done.*

In the very complete tests being run under the auspices of the National Electric Light Association and the Association of Edison Illuminating Companies (Report of Street Lighting Committee, N. E. L. A., 1914.), both the intensity of the illumination falling on the street and the brightness of the surface have been measured; and it is to be hoped that the data accumulated will furnish a more complete guide for the interpretation of street illumination values.

It is evident that lamps hung over the street need be higher than if located along the side. The general tendency is to place lamps too low. High power lamps and those having high intrinsic brilliancy need to be placed higher than low power lamps, or lamps with light diffusing equipment. Also, lamps which emit a larger proportion of light downward should be hung higher than those which distribute the light at wide angles.

For high power lamps, hung in the center of the street, the height in practice runs from 20 to 35 feet, or even higher. It is seldom advantageous to hang such lamps less than 25 feet above the ground.

High power pendent lamps, along the curb, are usually from 18 to 25 feet from the ground, but pole top lamps with diffusing globes are often placed as low as 14½ feet. Small units along the curb run from 10 to 16 feet.

Intensity.—Intensity is the measure of the brightness of a light source or of the illumination falling on a surface.

The intensity of a light source is measured in candle power. The candlepower of most units varies for different directions, altho for nearly all types the distribution is symmetrical with regard to the points of the compass. Some sources do not give a steady light, so that the candle power varies from instant to instant.

The candle power of a lamp is subject to depreciation with time, due to various causes, such as shrinkage of the light source, depreciation of luminous material, accumulation of deposits on the surrounding glass (products of combustion, or evaporation peculiar to the illuminant), or to dust and dirt.

Thus, we see that candle power is a very indefinite term and, unless we specify other conditions, does not represent an accurate value. In the case of incandescent electric lamps or gas mantles, it has become the practice to rate in terms of mean horizontal candle power, i. e., average candle power given in a horizontal direction, with new lamps and test conditions. Hence, this value is understood when nothing else is specified. Otherwise, it is necessary to qualify the candle power, defining it with one or more of the following qualifications: Initial candle power, average candle power thruout life or trim, maximum candle power, minimum candle power, candle power at a specified angle of elevation, mean spherical candle power, mean (lower) hemispherical candle power, mean horizontal candle power, mean candle power from 0 to 60 degrees, etc.

When we have the mean spherical candle power, or mean candle power, in any zone, we may determine the flux of light in lumens, by multiplying by the solid angle corresponding.

For example: The total lumens emitted by a light source is equal to the mean spherical candle power times 12.57.

The lumen, being a newer unit and less familiar to the laymen than the candle power, is sometimes looked upon with suspicion and disfavor. In reality it is more definite than candle power, unless the latter is elaborately explained. Since the unqualified lumen is the highest value obtainable, it is less liable to be used to

SINGLE-LIGHT *ornamental pole and pendent fixtures in use in Hartford, Conn., on the narrower business streets and to extend the lighting on principal wide streets away from the business center. Note the arc light on arm over street and the low ornamental light clusters in the background, showing that no complete design has yet been installed.*

deceive, either thru ignorance or intent.

Intensity of illumination falling on the street is measured in foot candles (in scientific circles some times called meter candles). This may refer to the intensity on the horizontal surface of the street, on a plane normal to the light rays, or a vertical plane. Measurements of either horizontal or normal foot candles, for particular points in the street, are made by means of portable or illumination photometers. Recently measurements of average brightness of street surface have also been made.

With regard to the horizontal and normal intensities, there is some difference of opinion among lighting experts as to which is the most correct measure of the value of the illumination. The horizontal foot candles measure the illumination falling on the flat surface; the normal foot candles, the brightest illumination on an ordinary obstruction. For high intensity it is common practice to use the horizontal value, while for low intensity lighting, especially with wide spacing, the tendency is toward the use of the normal.

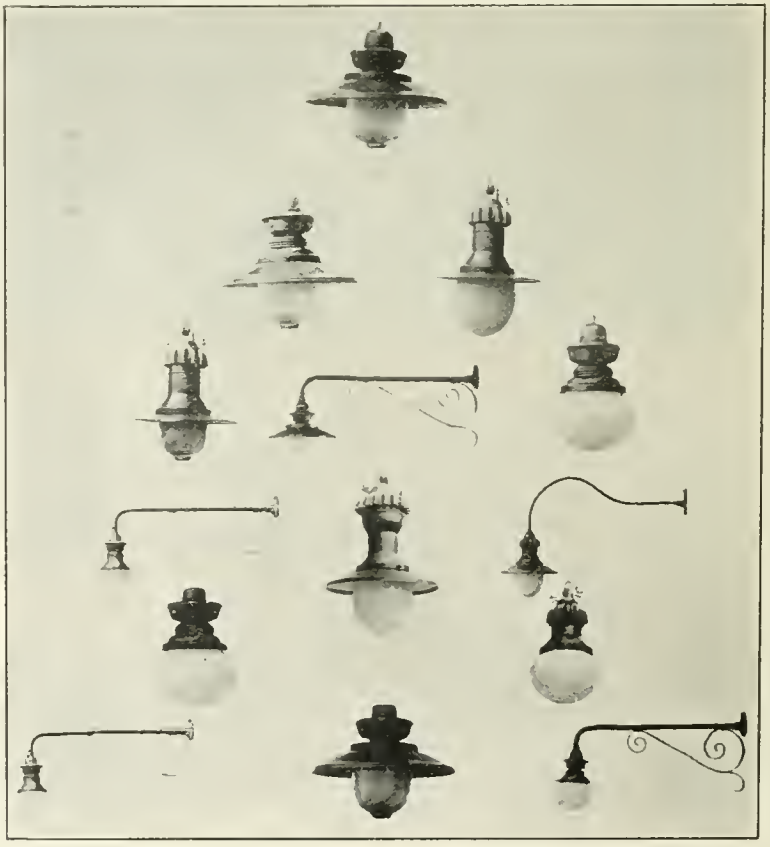
Under the latter condition it is often very difficult to make horizontal measure-

ments; moreover, it is generally conceded that the normal values give a fairer measure of the usefulness. The two values cannot, usually, be compared directly. Both values can be calculated from candle power curves, for points at a known distance from the illuminants. The calculated horizontal illumination from two or more sources may be added to give the total intensity, but normal illumination represents only the illumination from one lamp.

Since each calculation determines the intensity at one point only, it will be seen that considerable calculation would be necessary to determine the illumination thruout a representative section of street. It is common to give the values at representative points, as, along the center line, halfway between lamps, directly beneath lamps, or to plot curves showing rate of variation or lines of equal intensity.

By dividing a section of street into squares and assuming that the horizontal intensity in the center of each square represents the mean intensity of the square, it is possible to determine the average intensity on the street surface.

It is possible to figure from the above the flux of light over a section of street (foot candles times square feet, equals lumens), but it is more common to figure the illumination in terms of intensity.



GROUP OF PENDENT FIXTURES *for Mazda street-lighting lamps, showing some of the varieties of style available.*

A MODERN FRANCHISE

FOR A PUBLIC SERVICE CORPORATION

By Charles Carroll Brown, M. Am. Soc. C. E., Indianapolis, Ind.

This brief resume of a recent franchise granted by a small city shows what is easily possible in renewing an expiring franchise in securing terms more scientific in their nature than were contained in the old franchise which it replaces. Rates may be too high, but they are the best the city council could secure with their present lack of knowledge of all the facts. The future control is sufficient to bring rates to their proper level at the end of the first five-year period.

PERHAPS a better title for this paper would be "A Recent Franchise," etc., because the franchise in question is not in all respects modern. A discussion of it will be of interest mainly to show what may be obtained in the way of a new contract by a small city in a state in which there is no public service commission and no particular machinery for the control or regulation of public service corporations, when such a city wishes to renew a contract made years ago with a local organization which has since been absorbed by a great corporation owning many plants in various parts of the country.

The former franchise was one which left nearly everything in the hands of the company operating under the franchise, but fixed the rates so that they were not excessive under the former conditions. The term of the franchise was fixed and as it was about to expire the company offered new rates which were not well understood by the city authorities. They concluded that they needed expert advice and secured it. The contract includes both water and electric light service. With the advice of their experts and their suggestions of a form of contract they entered into negotiations with the company and after nearly a year of discussion they succeeded in working out a form of contract which is satisfactory to both parties. The city officials intrusted with the formation of the contract were competent business men and attorneys who were working for the best interests of the city. The resulting contract may be considered to be a fair sample, therefore, of what can be obtained by this method of negotiation, it being remembered that the experts were not called upon to pass upon the final form of the contract, their assignment having been completed when they presented their report of a form of contract which they would recommend and rates which they considered equitable for both parties. It might be mentioned that the new rates offered by the company appeared to the city officials to give a reduction in price of electric light to private consumers, but examination by the experts demonstrated that they would have resulted in a material increase in the monthly bills of users of the current. The city is held as anonymous, as discussion may be somewhat more freely made if its location is not known.

The new franchise is not modern in its first provision, since it provides that the franchise shall be sold to the highest bidder and that it shall not be sold for less than $500. This meant simply that the company should pay the city $500 for the privilege of remaining in business. The company must make this price out of its profits. The company is required to furnish, free of charge, water required to supply one public drinking fountain, one ornamental fountain, as described in the franchise, and 4,000 gallons a day for flushing sewer tanks to be operated by

the company and maintained by them on the city sewer lines, also water for flushing streets and sidewalks and building them. The company is required to pay the city 2 per cent. a year of the gross receipts of operation, the city having the right to employ expert accountants to check up the reports of the company in case they are questioned. This payment must also be made out of the consumers and the rates must be large enough to cover it. The city is entitled as a corporation to a sum which will reimburse it for its necessary expenses on account of the presence of the pipes, wires, poles, etc., on and under the streets, and the construction of extensions thereof, and this 2 per cent. allows for this and it increases in total amount as the business of the company and presumably its burden on the streets increases, so that this payment would seem to be justified if the amount of it has been properly determined.

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¶ THE DETAILS OF APPARATUS *and methods of construction are given with sufficient fullness to enable the city to secure what it asks for in service and in improvement thereof from time to time.*

Definitions of terms and of notices are properly made and the company is required to keep an office open in the city during business hours. Its general duties of furnishing water and light service to city and citizens are clearly defined, and a few special details are prescribed.

The detail of methods of construction is set forth and is as full and modern as possible and still permit the continued use of the apparatus already constructed and in use, and need not be given except as to improvements provided for as shown later.

Interference with apparatus or use of the same by the city or other companies or persons already in the streets or allowed therein by the city is not permitted, and bond of the company to indemnify the city against any damage from this or any construction or maintenance operations is provided in the sum of $5,000.

The company is required to produce 100 pounds pressure on gages at plant and fire headquarters within five minutes after alarm and is carefully limited as to liability for fire loss in case this cannot be done on account of circumstances beyond its control.

¶ EXTENSIONS AND CHANGES *in existing details are provided for at expense of city or of company, as was deemed equitable by council and company.*

Permits for excavations must be procured by the company from the city and work constructed without such permits can be ordered out by the council. In case the city wishes poles relocated the company pays for the first relocation and the city pays for subsequent relocations. Provision is not made for relocation or lowering water mains with change of grade.

The city can use the company's poles for fire alarm wires, but must indemnify the company for any loss or damage on account of such use.

The provisions for extensions are numerous. The city may increase the number of public hydrants and street lights at will and the company must put them in within sixty days or city will deduct $1 a day for each day until put into use. The city must add a hydrant for each 500 feet of water main extensions it orders and if extensions are less than 500 feet long the property owners must agree to take enough water to give the company an annual revenue of 8 cents per foot of main laid, the city's hydrant being put in later when the extension is again extended to make it 500 feet long. Extensions less than 200 feet long shall be made at request of property owner, provided he bonds himself to take and pay for water supplied him for at least five years. They must be made if more than 200 feet long if the property owner pays the whole cost of the extension, but he will not be required to pay any water rent until his bills for water furnished equal this cost, after which time he pays rental as other consumers. Connections to properties on lines of mains shall be made on request,

payment of $5 for making the connection complete to the curb or grass plot in front of property, and making contract for water at price not less than $5 a year. Extensions for electric service less than 350 feet long shall be made on request, and if more than 350 feet long on payment of the cost of the excess over 350 feet. Thirty, sixty and ninety days' time are allowed the company for the work of making house connections, short and long extensions respectively.

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¶ RULES, *regulations, kind of service, are provided for, and penalties for violations or failures by company, city and private consumers are imposed*

The company can make necessary rules and regulations, subject to approval of council, and council will pass ordinances approving them, preventing pollution of water and injuries to property. Rules, regulations and rates must be applied to all consumers without discrimination. Violations of rules or non-payment of bills subject consumer to shut off, and such delinquent consumer must pay 50 cents in addition to the bill before service will be turned on. This provision does not state definitely what will happen in case the consumer moves away leaving an unpaid bill, or the property changes hands and the seller leaves an unpaid bill. Failure to furnish service for thirty days subjects the company to forfeiture of franchise, and for less time to forfeiture of double the rates for city service for the time the failure extends. Private consumers on meter rates pay actual service and minimum rate does not apply in such case. Deductions are made for single hydrants or lights out of service at double the contract rates if out of service more than three days, or at schedule rates for less time. Service is defined for hydrants as in good working order and constantly supplied with water; and for street lights as burning from one-half hour after sunset until one hour before sunrise. The question of whether failure to supply the service is unavoidable or the fault of the company may be referred to the board of arbitration provided later, in case of disagreement. Responsibility for reporting hydrants and lights out of order is put on the chief of police.

The city's bills for service rendered are paid in city warrants due six months from date, with 6 per cent. interest, and may be paid at any time before they are due.

Complaints as to justice of action of the company regarding granting or refusing service can be referred to the council, whose action is final.

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¶ RATES *for city service and for private consumers for water and light are given in full and are in general conformity with rates in other small cities under similar conditions.*

Rates for city service are as follows: Hydrants, $42.50 for each of first 65, and $40.00 for each additional; water for city purposes, except the free water above noted, 10 cents per 1,000 gallons; hydrants to be maintained by company and used by city for fire purposes and for flushing streets and mains and for building and repairing streets; damage to hydrants by fault or negligence of city employes to be paid for by city. For street lights, $70.00 each for first 46 6.6 amp. enclosed A. C. 500-watt lamps, and $60.00 for additional; $19.00 for 40-c.p. tungstens, $24.00 for 60-c.p., $32.00 for 80-c.p. $40.00 for 100-c.p., lamps to be maintained by company; light in city buildings at 3 cents per kw.hr., including school buildings, meters and connections furnished by company.

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¶ NEW AND MODERN STREET LAMPS *are provided for, also a meter for determining amount of current used, tho lamps are paid for at flat rates.*

New street lamps are to be 500-watt or more A. C. enclosed arcs, incandescent tungstens or their equal. City locates lamps and may change from arc to tungsten or the reverse without charge. Changes in location of old lamps made within ninety days of making of contract are without charge, but those made later

are at charge of city. When changes of types of lamps are made the city may raise the question of rates for new lamps and if parties cannot agree, the question may be referred to the arbitration board later provided for.

When the city requires, a specified ammeter will be installed to measure the current used in street lighting, to be paid for and operated at equal cost of city and company.

Water rates for private consumers for quantities used per month named are as follows: 1,000 to 20,000 gallons, 30 cents per 1,000; 20,000 to 40,000, 25 cents; 40,000 to 60,000, 20 cents; 60,000 to 80,000, 15 cents; 80,000 to 100,000, 10 cents; over 100,000 gallons, special; with a minimum of 50 cents a month from October 1 to March 1, and $1.50 from April 1 to September 30. Meters must be installed on all service within nine months, provided that not more than twenty-five meter installations per month can be demanded. All meters must be kept in good, accurate running order. Flat rates are provided to be used until the meters are installed, the number of flat rate consumers being reduced rapidly. Discount of 10 per cent. is made from bills if paid before 10th of month, but bill cannot be made less than the minimum above.

¶ AN ARBITRATION BOARD *for fixing rates and settling other possible contests over certain provisions is provided for in case city and company cannot agree at end of five-year period or other date of proposed changes.*

Electric power and heating rates to private consumers are subject to special contract; lighting rates are as follows: 0 to 30 kw.hr. (presumably used per month), 12 cents per kw.hr.; 30 to 60, 10 cents; 60 to 150, 7 cents; 150 to 200, 6 cents; 300 to 1,000, 5½ cents; over 1,000 kw.hr., special; subject to 10 per cent. discount if paid before 10th of month. Meters must be furnished and kept up by the company and tested free of charge at request of customer.

The rates for public and private service quoted above are fixed as the maximum for five years, and are then subject to change by agreement.

If the city and company cannot agree upon the new rates a method of arbitration is provided, which has already been in successful use in another small city under similar conditions. It is as follows: "At no time during the term of said franchise shall the maximum rates to be charged said city or its inhabitants for water or electric current be higher than the maximum rates herein fixed. If the city and the grantee shall be unable to agree upon the revision of rates herein provided for, such rates shall be fixed for said five year period, in the first instance by any state body created by law for such purpose; or, in the absence of such state board, such rates shall be fixed for said period by a board of arbitration of three wholly disinterested and competent engineers, none of whom shall be employed by or connected with the grantee or the city, to be organized as follows: One member shall be selected by the city and one member by the grantee, and these two members so selected shall select the third member. In the event the city or the grantee shall fail or refuse to select a member of said board of arbitration, or the two members of said board selected by the city and the grantee shall fail to select the third member of said board, either said city or said grantee may apply to the judge of the circuit court, asking said judge to select a member of said board to fill such vacancy therein, and the member of said board selected by said judge shall have full power to act with the other members thereof." Some details of procedure are included. One significant addition to the above provision, which has been worked out by the company, reads: "On all questions, except as to rates, such board of arbitration shall be three disinterested, competent persons." In the light of some experience of the writer in securing a disinterested, competent board under a provision similar to the above, except as to the last sentence quoted, this sentence indicates the intention of the company to have its member of the board an advocate of its side of the case.

In proceeding for determining rates the

board is not to take into consideration any value of the franchise, except so far as the 2 per cent. of gross expenses, which is paid to the city, may be so considered.

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¶ CONSTRUCTION OF A WATER FILTER *under approval of city and of State Board of Health is prescribed.*

A special provision in this franchise gives the company a year to begin the construction of a filter for the water supply and six months more in which to complete it and put it in operation. Due penalties for failure to perform these duties are provided, also for failure to operate the filter satisfactorily. Plans and specifications for the filter plant must be approved by the city and by the state board of health. If the company fails to supply water satisfactory to the state board of health for any five days, after the filter is in full operation, the company must pay a fine of $5.00 a day for up to ten days; $10 a day up to fifteen days; $20 a day up to thirty days, when the franchise will be forfeited unless the failure is due to circumstances beyond the company's control, in the opinion of a board of arbitration appointed as above. In case the board decides in favor of the company, it shall still pay the $20 a day fine for such time as the quality of water is below the state board of health standard, and such other damage as the city may prove itself to have sustained on account of such impure water, or that its inhabitants have sustained. At any time the city is dissatisfied with its water supply as to quality, it can call in the state board of health and if that board so decides, the company must bring its water supply up to standard within thirty days or forfeit its franchise, unless the failure is not on account of its own negligence, such question to be decided by the board of arbitration. The state board of health must approve of any new system or source of water supply. These provisions leave the company free to take water from any source it desires, provided it can bring such water up to the requirements of the state board of health, and at the same time enables the city to enforce the supply of a sanitary, safe and palatable supply. The application of these provisions is suspended for the eighteen months until the filter plant is in operation.

The rates may be considered rather high, but it must be remembered that they can not be raised during the term of the franchise, but may be lowered at any five year period. It should also be noted that the city has at the present time no information as to the operations of the company, but, by the terms of this contract will have considerable information, as well as the aid of the board of arbitration, at the ends of the five year periods, tho the board will not have as much opportunity to secure the necessary knowledge in detail as it should, since the company has prevented the insertion of a clause giving the board of arbitration the right to examine the books of the company, and the city has not reserved any such right, except as to the gross proceeds of operation.

The writer will not attempt at this time any extended comment on the provisions of this franchise. They speak for themselves. He will only call attention to the safeguarding of the quality of service, both water and electricity; the revision of rates at the option of either party at intervals not too great and by an expert board; the control of sanitation by the state board of health. With the exception of one or two details concerning which the company has not agreed with the consulting engineers of the city, it is believed that these controls are as safe as they can be in a state without a well-established, competent public service commission. Rates may be too high to begin with, but they are subject to reduction at the end of five years. It should be remembered, also, that some of the controls assumed cost money, and that the company must make a material addition to its plant to provide the better water supply demanded. It is also a fact that the city was not objecting to the rates in force, but its demands were almost entirely for pure water and plenty of it, and for modernizing to some extent the street lighting.

TREATED WOOD BLOCK PAVEMENTS

THEIR HISTORY IN THE UNITED STATES

The history of treated wood block pavements in the United States covers a period of nearly twenty years, really beginning with an experience in Indianapolis with a modern untreated block pavement, laid with wood, slow to decay, but too soft for heavy traffic. It shows a rapid development in the use of this form of pavement, due to the excellent qualities it exhibits, and shows the many changes made in details of treatment and of construction which experience has brought about. This outline is from a report of a committee of the American Wood Preservers' Association.

THE first use of untreated wood blocks as a paving material in the United States is said to have been in a pavement laid in New York City about 1835. Before 1840 Boston and Philadelphia laid pavements of spruce and hemlock blocks, which cost from $2.00 to $2.50 per square yard. The use of untreated wood blocks for pavements was soon taken up by other cities and a large variety of species were employed, such as tamarack, Douglas fir, and redwood. Large amounts of round blocks, mostly cedar, were also used, especially thruout the Middle West.

In the early use of wood blocks considerable attention was given to the form of the blocks and a number of these were patented. The Nicholson block, patented in 1848, was extensively used between 1860 and 1870. These blocks were rectangular in shape and gave a much more even surface than many of the other forms used.

During the sixty years preceding the use of treated wood blocks many cities laid large quantities of wood pavements at great expense. These were satisfactory at first, but they soon decayed, and in a comparatively short time after laying they had to be removed. Subsequent to 1871 over 1,000,000 square yards of untreated wood block pavement were laid in the city of Washington, D. C., costing from $2 to $4.20 per square yard. Nearly 30 per cent. of this was removed six or seven years after it was laid, and by 1889 the last of the blocks had been removed. Similar trouble was experienced by other cities using untreated wood as a paving material.

In most of the early wood block pavements little care was taken in the selection of the wood used, or in protecting it from decay. Often the blocks were laid on a plank foundation, placed directly on the ground, or upon a sand base, thereby creating a favorable condition for decay.

While both wear and decay are the principal causes of the failure of wood block pavements, decay is by far the most destructive agency. After years of repeated failures attention was directed to the use of wood preservatives.

In 1882 to 1885, wood blocks treated by the Wellhouse process were laid in St. Louis on Pine and Oliver streets, and are said to have remained there until worn out by traffic. The blocks were treated by the St. Louis Wood Preserving Company and were guaranteed by the contractor for nine years.

One of the first treated wood block pavements was laid in Galveston, Texas, about 1874. A pavement of about 75,000 square yards of longleaf pine blocks was

laid at this time and was in service until 1903, when it was removed. It is not thought that these blocks were given the same kind of treatment that is usually given at the present time. They were laid on a sand foundation, no concrete being used. Details of the treatment of these blocks are lacking.

¶ THE FIRST EXTENSIVE USE *of modern creosoted wood block for pavements was begun in Indianapolis, which city still has some of the early streets in use after nearly twenty years.*

In 1896 Indianapolis laid a few streets with blocks of Washington red cedar. These blocks were thoroly dried and then placed for six hours in a bath of creosote, which was heated to a temperature of over 210 degrees F. The absorption was estimated to be about 3 pounds per cubic foot. No expansion joints were used and considerable trouble was experienced on account of swelling. These blocks are still in use and are said to be in a good state of preservation.

It was realized that the best results could not be obtained by dipping the blocks, and in 1898 the first pavement was laid in Indianapolis of blocks treated with creosote under pressure. Longleaf pine was used and was given a treatment of from 10 to 12 pounds per cubic foot. At this time no particular attention was given to the character of the oil. This pavement, altho now reported to be in bad condition, gave such good results that city engineers began to appreciate the possibilities of treated wood blocks.

The first wood block pavement used in the East was laid on Tremont street, Boston, in 1900. The blocks were treated by the creo-resinate process, in which a mixture composed of one-half creosote oil and one-half resin was used. The object of adding the resin was to render the blocks more resistant to the absorption of water and to assist in retaining the creosote oil in the wood. This pavement is still in good condition. A sample pavement of this kind was also laid on State street, Brooklyn, N. Y., in 1902.

In 1899 one of the two roadways on the Rush street bridge in Chicago was paved with creosoted longleaf yellow pine blocks and the other roadway with untreated blocks. This afforded a good test of wood pavement, as the traffic on this bridge was probably heavier than on any other street in Chicago. It was necessary to remove the untreated wood blocks at the end of three years, whereas the creosoted section was in good condition at the end of seven years and gave indications of good service for several years more. They were then taken up on account of the untreated plank foundation being decayed.

One of the first creosoted wood pavements in Chicago was a section of longleaf pine blocks laid in front of the Auditorium hotel in 1900.

¶ THE LARGER CITIES *soon recognized the value of wood blocks for pavements and are using large quantities.*

The excellent satisfaction given by these treated pavements, which were largely experimental, resulted in a very rapid increase in the use of wood blocks thruout the country. The larger cities in particular recognized the merits of wood blocks for streets subjected to heavy traffic, as well as for residence streets. Wood pavements in Boston, New York, Chicago and other cities were installed under severe traffic conditions, where the relative durability could be compared with pavements of other materials on the same street. Many of the other types of pavements which were under similar traffic conditions failed, while wood block remained in good condition. The durability, noiselessness and other desirable features of treated wood blocks have been realized more particularly within the last five or six years.

At presently nearly thirty miles of the most heavily traveled streets in Manhattan Boro, New York, are paved with treated wood blocks. In 1912 New York laid about 225,000 square yards and over 180,000 square yards in 1913. Chicago had over 600,000 square yards in 1912 and laid over 165,000 square yards more in 1913.

CREOSOTED WOOD BLOCK *pavement on First avenue, Birmingham, Ala.*

Minneapolis was one of the pioneer cities in the use of treated wood pavements, and has probably laid as much as any city in the country. The city already has over 1,000,000 square yards and expects to add about 175,000 square yards in 1914. By January 1, 1914, Detroit had over 458,000 square yards of treated wood pavement, having laid over 166,000 square yards of this in 1913. A number of other cities are also laying large amounts of wood block pavement each year.

Species of Wood.—Southern longleaf yellow pine was most used in the earlier treated wood pavements. This wood has been found by experience to give excellent satisfaction and is most largely used at the present time. Other species that have been used are tamarack, Douglas fir, hemlock, Norway pine, maple and black gum.

The species most generally admitted by various specifications comprise longleaf yellow pine, Norway pine and tamarack. Black gum has been used to some extent in the East, but it is claimed that this species has not been entirely satisfactory. Douglas fir is used to a considerable extent in the far West.

Tamarack has been used in several cities and has given good satisfaction. In order to obtain more complete knowledge on the relative value of the various species of wood for paving purposes, the United States Forest Service laid an experimental pavement in co-operation with the city of Minneapolis in 1906. The woods used in the experiment were creosoted longleaf pine, tamarack, Norway pine, western larch, white birch and hemlock. Longleaf pine was used as a basis of comparison for the other species. The last inspection was made July 15, 1914, eight years after the pavement was laid. From the results of this inspection the species may be classified in the order of their efficiency in this pavement in the following order:

1. Longleaf pine.
2. White birch.
3. Eastern hemlock, tamarack.
4. Norway pine.
5. Western larch.

Undoubtedly, there are a number of

species of wood that would make satisfactory paving material, but on account of the incomplete knowledge of their value city engineers prefer a wood that has been tried and proved satisfactory. It seems probable that other species will in time be used more extensively than at present. The proper selection of the species of wood used for paving purposes is most important as it determines, to a large extent, the wearing qualities of the pavement.

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¶ DIMENSIONS OF BLOCKS *have varied from time to time and now vary according to use, economy and personal preferences of engineers.*

Depth of Blocks.—Recently there has been a tendency to reduce the depths of the blocks and at the present time 3½-inch blocks are frequently specified, and even 3-inch blocks.

New York City has adopted a 4½-inch deep block as standard in Manhattan, where it has been demonstrated that a 3½-inch block is not strong enough to withstand the heavy traffic. The Boro of Richmond (Staten Island) uses 3-inch block as standard. The Boro of Queens has some of the best wood-block pavement in this country and after nearly ten years' service 3-inch deep blocks show practically no wear. The traffic is plentiful, but the vehicles not very heavy.

The blocks used in the early pavements were generally 4 inches wide. In more recent practice the width has often been reduced to 3 inches. This prevents the blocks being laid on their sides. The permissible length varies from 5 or 6 inches to 10 inches.

Specifications generally require that the blocks shall be sound, free from large or loose knots, shakes and other defects of that nature. There are differences in the number of rings per inch specified and in the amount of sapwood that is permissible. Some engineers allow the use of blocks having five or six rings per inch and others specify not less than eight or nine.

The amount of sapwood allowed usually varies from 10 to 40 per cent. In the early use of treated wood blocks, specifications were more rigid in the requirement of a larger percentage of heartwood. Experience seems to indicate, however, that treated blocks having both sapwood and heartwood show no noticeable differences in wearing qualities from those without sapwood.

Preservatives.—The earlier wood paving blocks were treated with a light grade of creosote oil. Later, due largely to expansion difficulties, varying amounts of tar were added. The bleeding trouble has recently led some cities, notably Chicago, to specify a very high-boiling creosote free from tar. This oil has the disadvantage of being high in cost.

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¶ HEAVY OIL *for treating blocks is popular at the present time under carefully drawn specifications as to quality of oil and treatment.*

Most of the cities in the United States are now using an oil having a specific gravity of 1.10 to 1.14, and containing a large proportion of tar, usually required to be nearly free from carbon. Such an oil is also permitted in the specifications for paving oils of the representative societies interested in this subject.

There is little difference of opinion as to whether oil from water-gas tar should be used. It is claimed that this cheaper product might be mixed with coal-tar oils without lessening the value of the pavement. Several experimental pavements have been laid using this product, and until the results of these experiments become available most engineers prefer to exclude water-gas creosote from their specifications.

Method of Treatment.—The earlier pavements were treated usually with from 10 to 12 pounds per cubic foot of oil. Engineers then went to the opposite extreme, until it was the general practice to inject 20, and in some cases even 24 pounds per cubic foot, resulting in a greatly increased cost and excessive bleeding of the oil. Recently the tendency has been to reduce absorption, and at present 16 pounds per cubic foot is about the average used.

The method of treatment first used was, in general, to subject the blocks to a dry heat of 250-280 degrees F., or to steam them at pressures varying from 25 to 50 pounds per square inch for periods varying from 3 to 4 hours, or more, depending upon the condition of the wood. A vacuum of 24 to 26 inches was then drawn to remove the moisture, after which the preservative was admitted without breaking the vacuum, and pressure applied until the desired absorption was obtained.

At present the method of treating the blocks is often left to the treating plant operators, the specifications merely requiring a given absorption. Some cities, however, outline the method of treatment in detail as to preliminary steaming, vacuum and pressure periods, giving the time, temperature, pressure, etc., for each operation.

Methods of Laying.—The old type of untreated block was generally laid either on a sand or a plank foundation, neither of which was satisfactory. Treated blocks were usually laid on a concrete foundation covered with a sand cushion, a method of laying which is still in quite general use. Much trouble has been experienced from the sand shifting or being washed from under the blocks, and thus producing an uneven surface in the pavement. Expansion troubles were also caused by water penetrating the spaces between the blocks and saturating the sand. A bituminous coating is now sometimes laid directly on the concrete base instead of the sand cushion.

While the sand cushion is still quite generally employed, there is a well marked tendency toward the use of a sand and cement mortar. This usually

CREOSOTED WOOD BLOCK *pavement in Americus, Ga.*

SHOP FLOOR *paved with creosoted wood blocks.*

consists of a mixture of one part cement to three or four parts of sand and is spread from ½ to 1 inch thick. This results in a more satisfactory pavement, especially under heavy traffic.

The foundation now generally adopted consists of a concrete base from 5 to 7 inches deep, depending upon traffic conditions, the mixtures commonly used being 1, 3, 5 or 1, 3, 6.

Joints.—In some of the early pavements laid no expansion joints were used, and in many cases no trouble has been experienced on account of swelling. In many other cases, however, much trouble has been caused through failure to properly provide for swelling of the blocks.

Streets on which the traffic is heavy do not require as much provision for expansion as do streets of medium or light traffic. In the Brooklyn and Manhattan pavements no provision is made for expansion. For a street 30 to 40 feet wide the expansion joints are usually ¾ to 1 inch wide and filled with bituminous filler. In most cities no joints are employed to take care of expansion lengthwise with the street.

The angle of courses is a point upon which engineers are not agreed. The most common method of laying has been at 90 degrees with the curb, but many of the streets are now paved with the courses at oblique angle. In the Minneapolis experimental pavement the blocks laid at oblique angle did not wear as fast as those laid at 90 degrees, since traffic was not directly across the joints of the pavement. Another advantage of the oblique angle of laying is that longitudinal expansion joints at the curb will take care of expansion in both transverse and longitudinal directions.

Filler and Top Dressing.—A bituminous or pitch filler was commonly used in the early treated wood block pavements. Bituminous or asphaltic fillers and also sand and cement fillers are the materials generally used at the present time for filling the joints. The advocates of the sand filler maintain that the sand fills the joints completely and that the surface of the pavement becomes practically homogeneous. It is claimed that a waterproof joint is formed by the sand absorbing the oil which exudes from the blocks. Others argue that the sand packs into the joints, thereby making an unyielding filler which does not allow expansion, but permits water to enter between the blocks, causing expansion of the pavement.

Advocates of the cement grout filler claim that the use of this material insures the joints being completely filled and waterproof. The mixture is usually made of one part cement and one or two parts sand, which, after mixing to the proper consistency, is swept into the joints.

Opponents of the cement grout filler claim that unless the pavement is kept free from traffic for a sufficient time to allow the grout to set thoroly the bond of the mortar will be broken. Even when the mortar is thoroly set it is claimed that its strength is not sufficient for traffic conditions, and the filler, therefore, serves the purpose no better than sand, while at the same time it is more expensive.

Those favoring the bituminous filler argue that the joints filled with a tar or asphaltic preparation constitute individual expansion joints between each block, thereby allowing for expansion thruout the pavement. Moreover, it is claimed that the pavement is made waterproof and that no moisture can enter between or under the blocks.

On the other hand, advocates of the other fillers argue that a bituminous material becomes soft and sticky from the oils that exude from the blocks and may add to the bleeding trouble. In practice, the bituminous fillers are most largely used and are giving the best satisfaction.

The top dressing most commonly employed is a layer of sand spread about one-half inch deep over the completed pavement. This sand fills up any small pockets that may be present and is more or less ground into the wood, making the pavement less slippery.

CANAL DE MANGUE

Rio de Janeiro, Brazil.

The sanitary condition of the East End, a portion of Rio de Janeiro, the capital of Brazil, rather low and swampy, has been greatly improved by the construction of a broad, beautiful canal which, besides being so picturesque, serves the useful purpose for which it primarily was constructed, that of draining the marshy ground and acting as a main outlet for the rain water that frequently comes down in torrents from the surrounding hills.

Rio is the home of the stately Royal Palm, for they are in evidence everywhere thruout the city. The Mangue Canal runs thru the center of the Avenida de Mangue, and there are four driveways along it, two on either side of the canal, as the Avenida is very broad. The accompanying photograph shows the canal and gives some idea of the bordering driveways.

WATER WORKS PLANT

OF RIVER FOREST, ILLINOIS.

By Karl M. Mitchell, General Superintendent.

This interesting account of the development of the water works system of a small city is prepared by an official who corresponds to the city manager, now becoming so popular. He conducts a department of municipal news in the local weekly paper, and the data in this article were collected for use from time to time in that department.

PROBABLY the most important and pressing problem of the village government today is that of its waterworks. The consumption is rapidly increasing, while the water level in the wells is rapidly receding.

Until May 23, 1893, River Forest was dependent upon shallow wells for its water supply. In that year, having attained a population of 500 to 600, and under the influence of the progressive spirit dominating the world's fair period, culminated a movement begun some time previously for the construction of a works and distributing system.

A deep well 1,000 feet in depth was bored, a steam generating plant, deep well pump and a service pump were installed, a reservoir and a standpipe constructed, and several miles of mains laid covering most of the village south of Chicago avenue and west of Lathrop. Even a public fountain was not overlooked, and was installed at Park and Lake, where it was maintained for many years, since replaced by one of the modern bubbly type.

The maximum output of the works at that time, with a population of 600, was 150 gallons per minute. The population has since been multiplied by six, and the output less than doubled.

A few years later the deep well pump was replaced by an air-lift system. In 1904 a second well was driven, also being operated by the air-lift system. This was the last change made that increased the output of the plant.

In 1911 steam was displaced by electricity as a motive power. In 1913 reservoir No. 2 was constructed, to increase the storage capacity for fire and emergencies.

During the entire period that the water works has been in operation, Ernest Micklish has been in charge. There has been no serious mishap. One large leak in Lake street, a few years ago, was occasioned by electrolysis. The Concordia fire last February was the only fire that has taxed the capacity of the plant. While the plant is not efficient, judged by present-day designs and methods, the machinery as installed has been well maintained and extensive repairs have never been found necessary.

The steam plant was not removed at the time the electric plant was installed. Most of it is in good condition and serviceable. It should be sold. The air compressor and pumps particularly are in good condition.

During 1913 there was a marked increase in water consumption, caused by the connection to the water system of the stores in the bank building, the dairy, the college, all of which were large users, and a number of private residences. At the same time there occurred a marked drop in the water level in the wells, and a corresponding increase in the distance the water was lifted. As the capacity of the plant remained constant it followed that the quantity of water raised per hour was diminished.

The water department faced a double emergency. The output of the plant,

which had been scarcely equal to the maximum demand in the summer of 1913, had decreased, while the consumption had increased.

A series of tests was conducted during the winter of 1913 to ascertain the operating conditions, to indicate the most feasible method by which the anticipated shortage in 1914 could be avoided, and to determine if possible means for increasing the operating efficiency.

The tests indicated that the plant was operating at an over-all efficiency from wells to reservoir of 14.2 per cent. The component parts of the plant were then tested and results analyzed to determine where the greatest losses occurred, and what changes could best be made to increase both the output and efficiency.

These tests resulted as follows:

Equipment (wells to reservoir)	Individual Efficiency Per Cent.	Input H. P.	Output H. P.	Energy Consumed H. P.
Motor	92	46.9	43.14	3.76
Belt	95	43.14	41	2.14
Air compressor	63	41	26	15
Wells	25.7	26	6.7	19.3
Total	14.2	46.9	6.7	40.2

The efficiency of the motor and belt was reasonably satisfactory, while that of the compressor could be materially improved only by the installation of a new compressor. The lowest efficiency and greatest consumption of power was found to be in the wells.

It may here be explained that our works are operated on the air-lift system. Compressed air is conveyed down the well a considerable distance below the water line and released within an upright discharge pipe. The air rises rapidly in the discharge pipe, forming with the water an emulsion lighter than the water, the buoyancy of which, together with the pressure of the water from beneath in the submerged discharge pipe, cause it to rise and flow out of the top of the pipe.

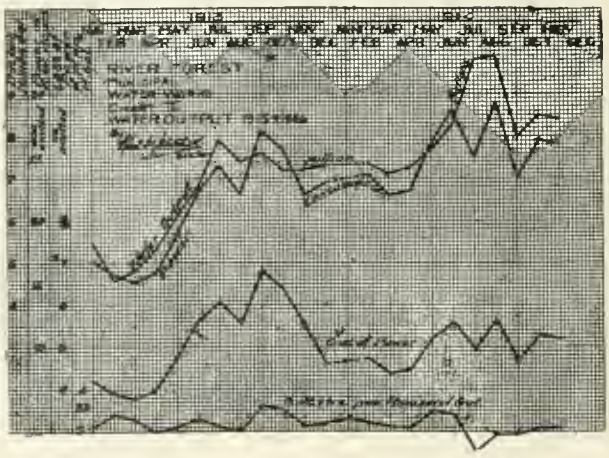
Its action is similar to that of the familiar coffee percolator, in which the expansive force, instead of compressed air, is steam generated at the bottom of the pot directly under a flaring hood or bell, which opens into a vertical tube. The steam collects under this hood until its expansive force drives it upward thru the tube to escape at the top, carrying with it a quantity of water which overflows.

The efficiency of an air lift depends upon the length of air and discharge pipes in the well, their size, the friction loss in the air line, the air pressure used and available, and the friction loss in the discharge line.

To secure the maximum efficiency from our air lift system will require the repiping of the wells so as to reduce the air and water friction losses, permit of a larger ratio of submergence, and a higher operating pressure.

Other important phases of the situation are also to be considered. The friction loss in a 6 or 8-inch well, such as ours, is greater than in 16 and 18-inch wells, such as operated by some of the neighboring suburbs. When pumped at a given rate the lift is less, i. e., the water level high-

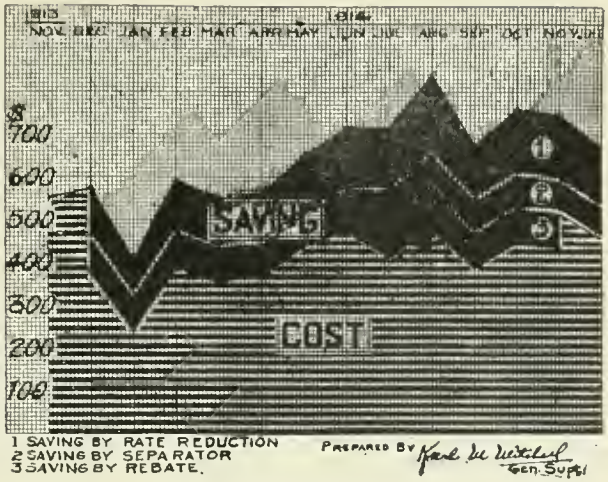
RIVER FOREST WATER WORKS. *Output of water, consumption and cost of power and rate of use of electricity.*



er, in a large well than in a small well.

The fact that the water level thruout this section is receding quite rapidly is of grave significance and suggests the possibility of the lift becoming so great, and consequently the power cost, that we may be obliged to secure Lake Michigan water.

The immediate problem last spring, however, was to provide sufficient water for the period of maximum demand in 1914, and to increase the efficiency if practical.



RIVER FOREST WATER WORKS. *Saving in cost of power by reduction in rate for electric current, by installation of air separator, and by rebate on bill for electricity.*

The most effective method to accomplish these purposes was determined to be the installation of a separator at the top of each well. Under the system then in operation the discharge pipe rising vertically from the well changed its direction and ran horizontally to the reservoir. As the operation of an air lift depends upon the buoyancy of the air, to be effective it must operate only in a vertical direction. When operated horizontally it becomes inefficient. A separator is simply a tank at the top of the vertical discharge pipe, which receives the water discharged, permits the air to escape, and which is elevated sufficiently to permit the water to flow into the reservoirs by gravity.

During the last of June a separator was installed on each well. Slight adjustment was also made in the length of air pipe in the wells, but within limits that could be operated by the present compressor.

The important thing accomplished by the installation of the separators was the increase in water output sufficient to avoid the threatened water famine and meet the unusually heavy demand of the summer.

In the table below is given the output of the water works in thousand gallons, by months, for 1914, with the increase in 1914, showing that the use of water in the earlier part of the year was much greater but not so much in the later months:

Month	1913	1914	Increase Thousand Gallons	Per Cent. Increase
January	5472	*4916	....	..
February	4616	7358	2742	59
March	4797	7102	2305	48
April	5280	7260	1980	37
May	6073	7717	1644	27
June	6819	8325	1506	22
July	7913	9772	1859	23
August	7380	9937	2557	34
September	7603	7980	377	5
October	7179	8535	1359	19
November	7160	8392	1232	17
December	7264	7710	446	6

*20 days only.

These figures are shown graphically on chart I. There is also shown the power consumption in kw. hours; the cost of power, not deducting the rebate, and the power consumption per thousand gallons pumped.

The large increase in water consumption in 1914 is due to the increase of 15 per cent. in the number of connected services, some of which, as the stores in the bank building, the college and dairy, were large consumers, and to a dry season.

It will be noted that the consumption rose from around 5,000,000 gallons in the first months of 1913 to between 7,000,000

and 8,000,000 gallons in July, 1913, and that, instead of the normal drop that may usually be expected during the winter, the consumption was maintained at this figure thruout the fall and winter of 1913 and spring of 1914, until June, 1914, when it started upward again. In August the consumption was nearly 10,000,000 gallons, more than double that of February or March, 1913, and 11 per cent. in excess of the maximum output of the water works operating twenty-four hours a day for thirty-one days at any time before the separator was installed.

From the middle of May to the middle of June, tho we were operating twenty-four hours per day much of the time, our demand was in excess of our output, and we were obliged to purchase 680,000 gallons from Forest Park. The situation was critical. The shortage of water was real.

This condition had been anticipated, however, and, as a result of the investigations made during the winter, the installation of separators was authorized in June, and before the end of the month they were in operation and the famine averted.

Their installation increased the output of the wells 28 per cent., from 202 gallons per minute to 259 gallons per minute. This was for normal operating.

A test was made with both compressors running and an output of 385 gallons per minute secured, an increase of 183 gallons per minute, or 91 per cent. over the normal pumping rate before the installation of the separators. The water delivered during this test contained a considerable amount of milky white dust in suspension, and at the time occasioned some inquiry from consumers as to the cause. As this is the only test which has ever been made with both compressors running, it is not known whether the milky matter, probably limestone, will disappear after more prolonged pumping, but it is assumed that it will. This method of pumping is considerably less efficient than with one compressor only, and is not to be considered for regular service, but as a reserve for emergencies is of much value.

In addition to increasing the water output, the separators also increased the operating efficiency of the plant, raising a given quantity of water with one-sixth less power. This is indicated graphically in chart I, by the greater separation between the water output and the power consumption lines immediately after the installation of the separator, particularly when compared with the same months for 1913.

This is also indicated on the lower line, denoting the power consumed in k.w. hours per thousand gallons.

The fluctuations in the lower consumption per thousand gallons are due largely to fluctuations in the well levels and to changes in atmospheric and other operating conditions. The water level in the wells drops when under heavy pumping, and there is a gradual receding of the water level in all strata underlying the Chicago metropolitan district. An air compressor operates most efficiently in dry, cold weather. Its efficiency in damp and warm weather is lower, and the cost of power proportionately higher.

Up to December, 1913, our power rate was $0.025 per k.w. hour. During that month a reduction was secured based on a sliding scale, with a maximum of $0.02. In addition to this 20 per cent. reduction there was secured a rebate of $1,020, payable at the rate of $85 per month for twelve months.

During the twelve months ending November, 1914, there was paid for power $4,779.53. Had there been neither a rate reduction, rebate, or separator installation, the cost of power for the twelve months, based on the conditions existing in November, 1913, would have been $7,776.25. Two thousand nine hundred ninety-six dollars and seventy-two cents has therefore been saved during the year, distributed as follows:

Saving in cost of power, December 1913-November 1914:

By rate reduction	$1,587.20
By rebate	1,020.00
By separator (5 months)	389.52
Total	$2,996.72

This is shown graphically in chart 2.

The saving effected by the separator averaged $77.90 per month, or $934.80 per year.

February, 1915.

BRICK PAVING ON STEEP GRADES

A REPORT OF RECENT PRACTICE IN TORONTO, ONT.

By F. A. Churchill, Conneaut, Ohio.

The use of brick paving on streets with steep grades is a problem on which a number of engineers have been working for some years. The hillside block has been devised by brick manufacturers for use in such localities, and this paper describes the methods of construction of pavements, in which a special form of hillside block was used, and the satisfaction given by it.

THE city of Toronto, Canada, is constructing vitrified brick pavements by day labor. The work is being done by the Department of Works, under the direct supervision of M. A. Stewart, assistant engineer of roadways, and W. Barber, superintendent of construction, with W. C. Perkins, M. Am. Soc. C. E., chief engineer of the construction department of the Dunn Wire-Cut-Lug Brick Company, as consulting engineer.

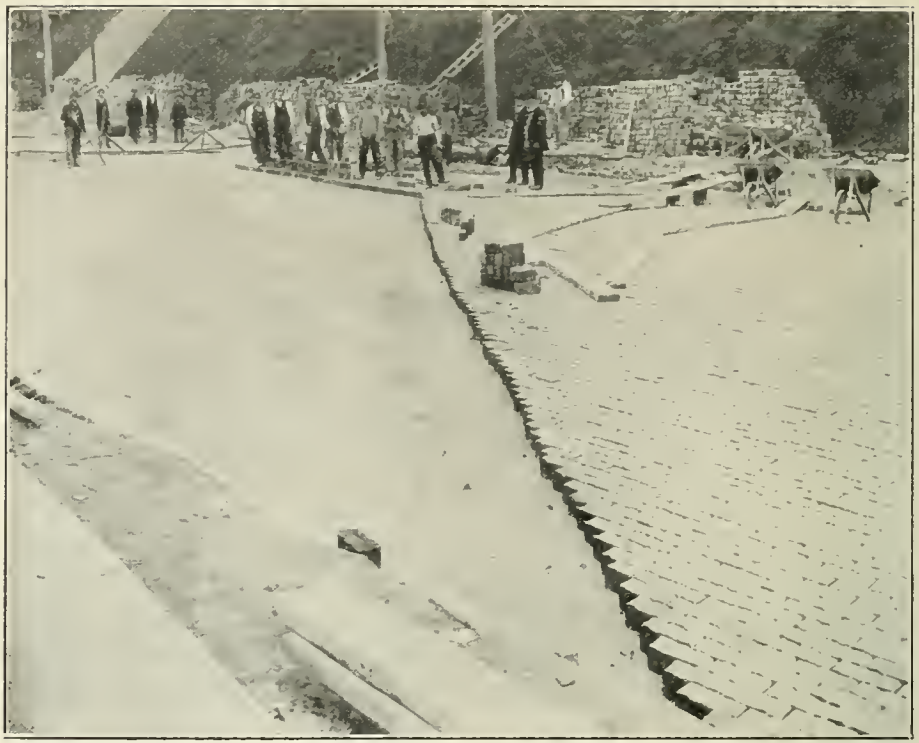
In Toronto, the long-debated question of the advisability of municipalities themselves doing constructional work on civic improvements of a major character, was long ago settled, whether success be defined in terms of dollars and cents or measured by standards of efficiency. Toronto now has a philanthropic motive in doing its own structural work. The war in Europe has borne heavily upon the business world in the Dominion, and thousands of men, women and girls are either out of work or are employed intermittently. The problem of caring for the worthy unemployed is a grave one. Canada is trying to solve the problem with courage, generosity and resourcefulness. It is said that the city of Toronto has had on its pay rolls six thousand men engaged in public works of various kinds, and the city will endeavor to give these men a daily wage as long as weather conditions permit.

The constructing of public improvements by day labor has been a blessing to thousands of wage earners, and has also proven to be sound economic policy, owing to the personnel of the engineering corps of the city government.

Up to the close of the year 1912 there were approximately 420,000 square yards of brick pavement in the city, laid on a concrete foundation varying from 4 to 6 inches in depth; 15,031 square yards laid on a broken stone base; 32,009 square yards laid on gravel. The first brick for paving construction was laid in 1895.

In 1913 there were 1,207,892 bricks laid. Of this number 727,160 were wire-cut-lug brick, the first laid in the city. They were first laid on Merton street, in North Toronto, from Yonge street to a point 2,300 feet east, as a test. The pavement was constructed 28 feet wide between curbs, on a 4-inch concrete foundation, with 1½-inch sand bed and cement grout filler, 1 to 1 mixture. A contract was let, on competitive bid, to the Bessemer Limestone Company, of Youngstown, Ohio, for repressed paving brick. Later the city satisfied itself that wire-cut-lug brick was preferable to repressed brick, and it asked the Bessemer Company to substitute the former for the latter at the same price.

In 1914 there were laid, by the day-labor organization of the city, approximately 1,523,200 regular wire-cut-lug brick, and 354,000 of the same brick by



CHRISTIE STREET HILL, *Toronto, showing method of laying hillside blocks lengthwise of street. Note how blocks break joint so that grooves do not match.*

contract, the only kind now specified. In 1915 it is anticipated that sufficient paving work will be projected to require approximately 4,000,000 brick; the realization of these hopes depending somewhat upon economic conditions resulting from the effect of the European war.

Toronto has made a notable departure in putting in a wire-cut-lug hillside brick pavement on Christie street hill, the second of the kind ever laid. This new type of brick combines the distinctive features of wire-cut-lugs, square edges and beveled ends with two transverse grooves, about three inches apart, on the wearing surface. The grooves are designed to give horses a foothold on steep grades. The bricks are laid longitudinally with the street. Joints are broken on each brick, so that, instead of extending in lines across the entire width of the street, as is the case with ordinary hillside brick pavement, each groove is no longer than the width of the brick. This affords shoe calks opportunity to get a grip almost anywhere, yet, as the grooves are broken up at short intervals, broad tires bridge them on alternate courses of brick and roll over the pavement without experiencing an appreciable jolt.

The United Brick Company, of Greensburg, Pa., in 1914 shipped to Toronto 143,000 wire-cut-lug hillside brick from their Conneaut (Ohio) plant, and another order of 100,000 has been placed for the steep grade in Bathurst street. The same company has the contract for furnishing wirelcut-lug brick in 1915.

Christie street hill has a grade of 6¼ per cent. It was paved 46 feet wide for a distance of 700 feet, with a double course granite block header at the base of the hill. The street curves on the grade, and the brick, running lengthwise with the street, were laid in such manner that the curves conform and run parallel with the curvature of the curb. The effect is extremely attractive, as will be

seen by an examination of the accompanying picture, which was taken before the pavement was grouted or rolled or cleaned off. No V-joints are needed on curves.

In structural details, the pavement has a natural sub-base; a 6-inch concrete foundation; a 1½-inch sand bed; cement grout filler, 1 to 1 mixture. Sand for the bed was taken from a cut on Bathurst street hill. The sand is extremely fine, but not gritty. It seems to be a sort of dry quicksand, but it is easily compacted into a firm bed, and shows no tendency to roll up or to mush in spots. At every stage of construction work the engineers were attentive to details, and every mechanical aid to good work was provided for the workmen.

The final constructional stage, the grouting, was given the close attention its importance demands. A rather coarse, well screened pit sand and a good quality of Portland cement were used for grout. These ingredients, 1 to 1, were first thoroly mixed dry and then they were reduced to the proper consistency by mixing with water in a grout box. The mixing in both instances was done by hand, and the grout in the box was stirred continuously until it was scooped out with shovels and poured into the joints of the pavement.

The grout box was a very serviceable and practical adjunct to construction, and as it differed from grout boxes in common use in the States, a brief description may be of interest to contractors. It is a rectangular box, made of planking, mounted upon two wheels about 12 inches in diameter and fitted with two 6-inch legs and two handles similar to wheelbarrow handles at the rear. The bottom joints of the box inside are finished with a triangular molding to prevent grout collecting in the angles. Because it can be trundled from place to place very easily, and because the wheels are so placed with respect to the axis of the box that the latter can easily be tipped so that the contents will flow to the lowered end of the box for scooping, the implement is both a labor saver and an aid to good construction. No grout was dumped. All was scooped and poured, a method which as-

CHRISTIE STREET HILL, *Toronto, looking up 6.25 per cent. grade. Wire-cut-lug hillside blocks not yet rolled or culled.*

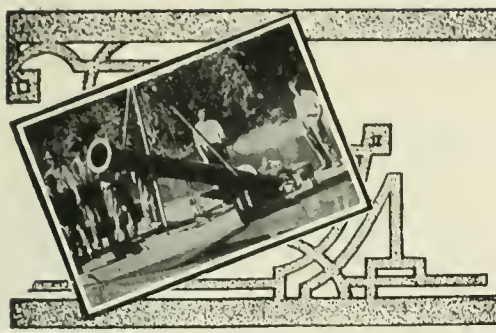
CHRISTIE STREET, *Toronto, under construction. Laying wire-cut-lug hillside blocks on 6.25 per cent. grade, city work by day labor.*

sures filling of the joints. In deference to the law of gravitation, grouting was begun at the foot of the grade, as otherwise the thin grout would have flowed down the longitudinal joints and overflowed the lower part of the pavement. Small quantities, by the shovelful, were poured at a time, and the surplus grout was quickly brushed forward up the grade. The final course of grout was squeegeed until the surfaces of the joints were flush with the pavement, care being taken to keep the joints full until the setting began. This assured a smooth, even surface.

After the final course of filler began to set, the transverse grooves in the brick were brushed out with wire brooms. The brushing was not really necessary, as the grout in the grooves wears out under the impact of horses' shoe-calks, but the process makes the grooves serviceable at once. The pavement was laid in November, 1914.

The Christie street hill is a beautiful piece of pavement, and its counterpart will be constructed on Bathurst street hill, possibly this winter, but certainly next spring. The level portion of Bathurst street, from the crest of the hill to Nina street, was paved with wire-cut-lug brick early in November, 1914.

The city safeguards itself in the purchase of materials by the competitive bidding system and also by submitting work to bidding by contractors, and some work is done by contract. It occasionally happens that the city rejects all bids as in excess of reasonable figures, and then readvertises. If the city finds that it can do its own work as cheaply as it can be done by contract, and is in position to handle it, the city does the work. This plan assures good work, as Toronto is fortunate in commanding the services of engineers who are not only capable but also conscientious.



EDITORIAL

CENTRALIZATION AND LOCALIZATION

In local matters home rule has been demonstrated to operate successfully. An editorial last month noted the demonstration of this statement which has been made in German cities and the delays and losses due to centralized control by various State Boards in England. Part of the inefficiency in the English system is due to the fact that, while the field in which each Board acts in centralized, the Boards themselves have no definite centralized control and there is the usual consequent duplication and red-tape delay.

Some governmental functions are, however, of a general rather than a local nature, tho the carrying out of the work belonging to them is largely entrusted to the local authorities. Of such nature are common school teaching and road building and maintenance. In each case it is true that the details are taken care of by the smaller units of local government while, very properly, the general supervision, determination of qualifications of the workers in the field, checking of quality of results, and the like is or should be in the hands of the State authorities.

The State of Indiana exhibits the consequences of two methods of treating these matters, which, while very different in processes and in the materials with which the work is done, and in methods of measuring results, still have many points of view in common.

Some seventy years ago the schools were in the same condition as the roads are at the present time. Each township operated its own schools, each school district controlled its own school and selected its teacher thru the designated official, there being no method of determining the qualifications of the teacher, no standard of compensation other than the money available, no standard of determining the results of the teacher's work and changing them if wrong. One teacher would perhaps learn how to teach to be moved on and his or her place taken by another of little or no experience. The analogy with present township control of roads and repair of roads by the district supervisors is complete in every item named above.

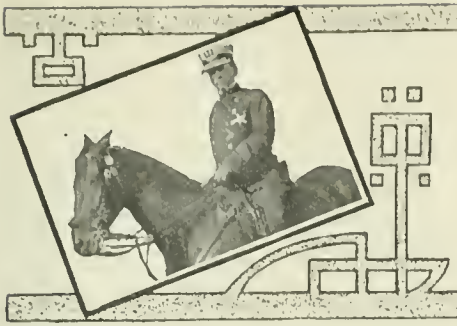
The school system of the State grew by the establishment of the county examiner to determine the qualifications of teachers; the State Superintendent to advise with county superintendents and teachers and aid personally,

in associations and by printed matter; the establishment of county institutes and of state schools for the instruction of teachers; the increase in requirements made of county superintendents in supervision and instruction of teachers; the continually increasing demands made of teachers as to preparation for their work and experience therein; the co-ordination and co-operation of city and country in bringing up the standard of instruction, in producing greater efficiency in methods of expending the money raised for educational purposes, in measuring results and changing methods to improve those results; the division of expense in part according to the desires and needs of the local communities, in part, especially as to supervision, according to the needs of the counties, and in part according to the population, especially as to funds derived from the State treasury more or less directly; the recovering of national aid and its distribution to localities thru a state authority.

All this program has taken seventy years to bring the school system to its present efficiency and the highly centralized system is now admittedly equal to if not the best in existencewhether measured by true economy of expenditure or by quality of results, demonstrating its high state of efficiency.

Every worker on the roads, every officer needed to secure efficient work, every process, method or result needed for efficient administration of the roads has its exact counterpart in the program laid down in the preceding paragraph. The present inefficiency in road work and extravagance in expenditure is due wholly to the fact that the road problem is just where the educactional problem was seventy years ago. It is to be hoped that the road question will not remain always seventy years behind, but that the lessons to be drawn from the development of one system can be applied promptly and rapidly to the development of the other.

It seems strange that two matters equally close to the hearts of the people, on which their advancement and prosperity depend to so great an extent should have had such different treatment. Possibly this is due to the less confidence of the people in their ability to manage all details of their educational activities, but that is doubtful. Possibly the difference lies in the early start made in educational lines when roads were so hopeless and money to make them was so infinitesimal that nothing could be done. Indeed, it is not thirty years since the first workable gravel road law was passed and the present really creditable condition of local roads in the State is the result of but thirty years of work. Just as in the school system, expert central guidance is needed to make the results more nearly commensurate with the expenditure of money and to bring to a higher quality and efficiency the main roads of the system which are in common use by the people and in only a very restricted sense local in their nature. It is no more just in the one case than in the other that the cities should be exempt from full participation in the cost of bringing up the portions of the system from which hey have the most benefit and the most direct benefit.



QUESTION DEPARTMENT

Forms for Electrical Inspection Work

I would like to get hold of a blank set of forms (applications for permits, etc.) such as used in connection with electrical inspection work in smaller cities. Can you furnish such a set, or refer me to a small city which is enforcing such an ordinance?

S., ———, S. D.

Will our readers send samples of the blanks they are using for the benefit of our correspondent? They may also be published for the benefit of others if permission is given.

Municipal Electric Light Plants.

Could you give me information about any of the following:

The lowest rate charged per kw.-hr. for lighting purposes by a municipally owned light plant in the United States;

The average charge in the United States per kw.-hr. by municipally owned plants compared with private plants.

We have a small town here of 5,000 people and own our water and light plant and the charge for current is 6 2-3 cents per kw.-hr. There is a movement on foot now to sell this plant and I am opposed to the sale and would like to get all the information I could that would be of help. If you could send me anything showing how towns had made mistakes, had their contracts broken, rates raised and unsatisfactory service I would very much appreciate the favor. B., ———, Tenn.

These questions open up the whole vexed question of municipal versus private ownership of public service utilities, but there will be no attempt to discuss them here.

The first question cannot be answered directly without giving a wrong impression. Thus, Cleveland proposes to supply electric current from its large municipal plant at 3 cents a kw.-hr., and has done so with fair success from two small plants supplying limited districts which it has had in operation for some years. The price named in the question would probably not be too high under ordinary circumstances in a city of the size named in the question.

The Bureau of the Census made a study of central electric light and power stations in 1902 which is out of date as to actual costs because of the great improvements made in electric lighting since that date, but it may serve to make some comparisons between the results of municipal ownership and private ownership.

Thus the average income per arc lamp in use for commercial or other private service was $48.88 in private plants and $41.46 in municipal plants per year. For incandescent lamps the average incomes were $2.40 and $1.92 respectively. For arc lamps in public service the incomes were $83.20 and $69.88 and for incandescent lamps in public service $6.06 and $5.93 respectively.

These incomes vary somewhat with the population. Thus in privately owned stations furnishing electricity only, arc light incomes per lamp were as follows:

Population.	Commercial Service.	Public Service.
Under 5,000	$53.80	$65.56
5,000 to 25.000	46.63	71.66
25,000 to 100,000	43.04	77.12
100,000 to 500,000	42.72	83.44
500,000 and over	58.82	111.97

For incandescent lamps the incomes were as follows:

Population.	Commercial Service.	Public Service.
Under 5,000	$2.53	$8.74
5,000 to 25,000	2.32	6.93
25,000 to 100,000	2.72	10.15
100,000 to 500,000	2.11	6.32
500,000 and over	2.33	2.24

In purely electric municipal stations the corresponding variations with population are shown in the following:

Incomes per arc lamp per year:

Population.	Commercial Service.	Public Service.
Under 5,000	$44.74	$61.27
5,000 to 25,000	40.67	64.79
25,000 to 100,000	35.77	51.88
100,000 to 500,000	....	70.24
500,000 and over	....	110.36

Incomes per incandescent lamp per year:

Population.	Commercial Service.	Public Service.
Under 5,000	$2.01	$7.62
5,000 to 25,000	1.70	5.46
25,000 to 100,000	2.54	3.99
100,000 to 500,000	0.87	4.96
500,000 and over	....	4.58

It will be noted that the incomes are less in the municipal plants in every case but one, indicating lower rates.

Municipal ownership is exercised mainly in the smaller cities. Of the 17,797 arc lamps reported in municipal plants, 16,734 were in use in plants in cities of less than 25,000 population.

Incandescent lamps in private service were largely 16-c.p., while those in public service were largely 32-c.p. or more and are burned more continuously, accounting for much of the difference between the incomes in the two classes.

Taking the outputs of current reported and the total incomes therefrom, the private plants seem to have received 3.35 cents per kw-hr. and the municipal plants 3.49 cents.

These figures can none of them be compared with any certainty of correct conclusions because of the differences in methods of accounting in use in private and municipal plants and in different plants in each class. Few plants, either public or private, make proper allowances for such items as depreciation and interest on investment, working capital and reserves for contingencies. Municipal plants have the added difficulty of making the proper allowances for public service, in many cases no such allowance being made and in others the allowance being insufficient.

It is quite possible in the case referred to in the question that these allowances have not been made and the plant is not giving satisfaction because it has not been kept up to date and in prime working condition.

A decision for or against selling the plant should be made, in a state not having a public service commission, only after a careful study by an expert of all the conditions and the careful working out of a franchise which will give the city rather than the company the advantage as to control. A franchise which will insure that the company will receive full compensation for the use of its capital actually invested and the ability shown in the management and will at the same time give the public and private consumers the best service possible for the money they pay for it is the best for both parties in the long run. It takes an expert unbiased in favor of or against municipal ownership to draw such a franchise.

Mere difference in rates offered by a company should not decide the question. That is a matter which should be open for revision at intervals sufficiently frequent to insure that the consumers get their share of the improvement in service or lowering of cost which comes so often in the electric lighting field.

Municipal ownership seems to be successful in proportion to the distance the plant is from political manipulation. In cities where this distance is great the successes are marked. In cities where the plant is a political football the failures are just as marked.

Reference may be made to the article on "A Modern Franchise for a Public Utility" elsewhere in this number of MUNICIPAL ENGINEERING for some suggestions as to the matters which should be included in a franchise in case it is decided to consider seriously the matter of granting one.

Permanent Water Meter Record

We are desirous of getting an office record for our meter readings separate from the record that the man that reads the meters uses and we are taking the liberty of addressing you to inquire if you can not recommend a good form for us. We would like if possible to get a form that will show two or three years' readings on the one sheet and also a sheet that has only one name on it. This is to be a permanent record of the office and something that is simple and that will contain all the information that would be required for a permanent record.

D., ———, Mont.

Forms of water meter records for office and for the meter reader will be found in MUNICIPAL ENGINEERING, vol. xlii, p. 251; vol. xliv, pp. 233 and 522, and vol. xlvii, p. 293. The last named is a reproduction of meter reading book page and meter reading record published by the Buffalo Meter Co., Buffalo, N. Y. The American Water Works Bookkeeping System contains the best book for keeping the accounts of metered water customers, including the meter readings copied from

the meter readers' books, the amounts due and payments made. It is published by Engineering Publishing Co., 702 Wulsin Bldg., Indianapolis, Ind.

Gravity Concrete Mixers

I would like to know the names and addresses of several companies making gravity mixers, for making concrete, such as the Gilbreth Trough Mixer, described in the book "Concrete Construction" by Gillette & Hill.
P., ———, Porto Rico.

Inquiry may be made of the following firms: Automatic Concrete Mixer Co., 143d street and Southern boulevard, New York; Buffalo Concrete Mixer Co., Buffalo, N. Y.; Hains Concrete Machinery Co., 286 Fifth avenue, New York; Ransome Concrete Machinery Co., Dunellen, N. J.; Littleford Bros., 444 East Pearl street, Cincinnati Ohio; Union Elevator & Machine Co., 214 West Ontario street, Chicago, Ill.

Box Car Unloaders and Conveyors

Can you give me the address of several reliable parties or firms making box car unloaders suitable for unloading sand, soda-ash and lime into storage bins whose loading doors are closely adjacent to the tracks and are on the same level and conform to the shape of the box car doors?

At present we unload these materials from box cars into storage bins, the floors of which are on the ground level. The material is shoveled or wheeled in wheel barrows from the box car into the bins, which, of course, keeps the top level of the stored material from being much above the floor level of the car and requires a large floor area to store any considerable quantity of any of the materials. From the bins the materials are again loaded into wheel barrows, weighed and dumped into a pile in certain proportions and mixed by hand and again loaded into wheel barrows and wheeled to the back of the melting tanks and dumped and then sheveled into the tank hoppers to be melted.

Now we want to get away from all this handling by hand and have in mind a system of which I am asking you to supply me the names of concerns manufacturing the detail parts. We are thinking of a plant whereby we can mechanically unload the materials we use from box cars, each material into its respective hopper, from which it will be fed either into a vertical chain bucket elevator or elevator of some other type and elevated into storage bins some thirty or forty feet high. The various materials will then be fed by gravity out of these bins to a scale and weighed and then onto a conveying belt and to a mixer and mixed. The resulting mixture will then be elevated and carried by conveying belts to the backs of the various melting tanks and dumped into hoppers, which will feed by gravity into these tanks.
P., ———, Ind.

This seems to be a problem in conveying materials which should be solved with ease by the experts in picking up and conveying materials. Such firms as Austin-Western Mfg. Co., Chicago, Ill.; Thos. M. Roche, 829 Monadnock Block, Chicago, Ill.; Jeffrey Mfg. Co., Columbus, O.; Webster Mfg. Co., Tiffin, O.; Chain Belt Co., Milwaukee, Wis.; Link-Belt Co., Nicetown, Philadelphia, Pa.; C. O. Bartlett & Snow Co., Cleveland, O.; Robins Conveying Belt Co., 13 Park Row, New York, and others can supply designs as well as all or part of the machinery necessary.

Electrolytic Sewage Disposal

In your issue of February, 1913, p. 135, you describe "Municipal Plants for Electrolytic Sewage Purification." This article has appealed to me very much as being the proper method of sewage disposal for cities that are situated in an agricultural district. I would like to know if the process is patented, and if so, who is the patentee, and where could I reach the party by letter. We have in a radius of 100 miles some seven or eight cities with a population of from 2,500 to 20,000 inhabitants where the above described process appeals to me as being the only satisfactory solution of the sewage problem. Nearly all of these cities are polluting fresh water streams that are used largely for irrigation purposes, as well as domestic supplies. Complaints are becoming so numerous from the agricultural districts that use this polluted water that the city officials of the different cities will be compelled to abandon the present method of disposal. L., ———, Wash.

The writer has tried to obtain definite information from those interested in the electrolytic process of sewage treatment described in the above mentioned article and has been promised a full description when the Oklahoma City plant was put in good working order. Nothing having been received, it is presumed that the plant has not yet been made successful. The city engineer of Santa Monica, Cal., or H. V. Hinckley, consulting engineer, Oklahoma City, Okla., can possibly put inquirers in touch with the designer or patentee of the system.

Safe Specifications for Reinforced Concrete Sewer

Will you kindly tell me if the following specification for a drainage ditch is safe?

This work to be monolithic. Greatest depth about 14 ft. The sections to be round and the walls the same thickness clear around. Mixture 1-5 gravel concrete and the ditch runs rock, clay, sand and gravel with ground water.

The walls of the 72-in. and 60-in. arch are to be 5-in. thick, the walls of the 54-in. and 48-in. arch are to be 4-in. thick, the walls of the 42-in. arch are to be 3½-in. thick and the walls of the 36-in. arch are to be 3-in. thick. All walls to be reinforced with No. 9 wire fencing with meshes 6-in. by 8-in., equal to 0.2 lbs per sq. ft. B., ———, Ind.

At its last convention, held in Boston in October, 1914, the American Society of Municipal Improvements adopted standard specifications for sewer construction, and this drainage channel is deep enough below the surface to require the same

strength of conduit walls as a sewer would.

The section relating to thickness of reinforced concrete sewer pipe was not adopted, because the thickness proposed by the committee preparing the specifications was considered to be greater than is necessary, by the manufacturers of reinforced concrete pipe. They presented their idea of the proper thicknesses and the section was laid over for further consideration, and will come up for amendment and adoption at the next convention to be held in Dayton in October, 1915.

The following table shows the thicknesses of pipes of various diameters proposed by the committee and by the pipe manufacturers:

Diameter of pipe, inches.	Thickness in inches proposed by Committee	Manufacturers
24	3	2.5
30	3.5	2.75
36	4	3
42	4.5	3.5
48	5	4
54	5.5	4.5
60	6	5
66	6.5	5.25
72	7	5.5
78	8	5.75
84	8	6

It will be noted that with two exceptions the thicknesses proposed by the manufacturers agree with those given in the question, and in those two cases are 0.5 inch greater.

The section governing proportions of materials reads as follows: "The concrete used in the manufacture of cement concrete pipe shall be composed of a mixture of the best quality of portland cement, clean, sharp sand, and clean broken stone or gravel suitably graded and equal in quality to similar materials specified herein for concrete, and properly proportioned to produce a pipe that will comply with all the requirements specified in sections named, (governing method of making, tests and dimensions).

The sections governing reinforcement provide that the steel shall comply with given requirements of the American Society for Testing Materials; that it shall be either expanded metal, rods or wire mesh, equal in quality and design to that manufactured by the American Steel and Wire Company; that in pipes 24 to 48 inches in diameter the reinforcement shall be placed 1 inch to 1.5 inches from inner surfaces, according to diameter of pipe and that either one or two lines of reinforcement may be used; that two lines of reinforcement shall be used in pipes over 48 inches in diameter one 2 inches from the inner surface and one 1.75 inches from outer surface.

While it is probable that reinforced concrete pipe in length may be made better than continuous reinforced concrete pipe made in place, the thicknesses for the latter would not vary greatly from those for the former under the same conditions, and the absence of joints in a water-bearing, sandy soil might be a considerable advantage in favor of the latter.

Unless there are special reasons for requiring greater than the standard strength in the particular case described, either of the specifications given in the table should secure a sewer or drain of sufficient strength.

Proportions of Lime Mortar

Will you please advise us if you publish any tables showing the ingredients required to make one (1) cu. yd. of lime mortar in the various proportions, such as one part lime to 1-2-3 of sand. We desire these tables to show the proportions by weight of dry sand and lime. The quantities of sand may be expressed in terms of cubic yards, estimating the sand to weigh 100 lbs. per cu. ft.

We have in our office a table of this kind on Cement Mortar, prepared by Mr. L. C. Sabin, Asst. U. S. Engineer, and we are trying to secure the same kind of information applicable to lime mortar.

We are after authoritative information and if you have no tables of the sort above described, any information directing us will be appreciated. L., Pittsburg, Pa.

The writer does not know of tables of the kind mentioned. Merriman's "American Civil Engineers' Pocket Book" ($5) states that the lime in commercial barrels of about 200 pounds net will make about 2½ barrels of stiff lime paste. One barrel of the paste and three barrels of good sand will make about three barrels (0.4 cubic yard) of mortar. One barrel of unslaked lime will make about 0.95 cubic yard of 1:3 mortar. From the first statements made the barrel of unslaked lime would make about one cubic yard of mortar when mixed with 7½ barrels of sand. Also a barrel contains 0.133 cubic yard, or 3.6 cubic feet.

Baker's "Masonry" ($5) gives 2¼ barrels of paste from one 230-pound barrel of unslaked lime.

Can our readers refer our correspondent to a source of the desired information?

An article in MUNICIPAL ENGINEERING, vol. xxviii, p. 4, gives comparisons of strength of high calcium and dolomite lime to the advantage of the latter, but does not give any information as to volumes of the mixtures used. The "Hand Book for Cement Users" gives the same information and statement of trade customs regarding hydrated lime.

WORKERS IN THE FIELD

How to Apply Filler to Vertical Fiber Brick Pavement

The Editor of MUNICIPAL ENGINEERING:

Sir—I note in the Question Department of the January issue of your magazine the article on laying vertical fiber brick pavements, and also that the question is asked, "Just how should asphalt be flushed on and how much asphalt per square yard should be used where paving is laid on 1½-inch sand cushion?"

Vertical fiber brick are laid flat instead of on edge, have a recticulated or roughened surface, and the bricks are laid and rolled as is usual with brick pavements, and the asphalt in this type of construction is applied somewhat differently. Instead of using a pouring can and filling the interstices, a little different grade of asphalt than the ordinary asphalt filler is used and is poured from an ordinary bucket directly onto the brick, and it is pulled over the surface of the brick while hot by the use of a squeegee. It is necessary that the asphalt be extremely hot and have a wide range of temperature between its melting and congealing points in order to allow of the asphalt filler penetrating the interstices of the brick before congealing.

We are sending you under separate cover a copy of our asphalt filler book and would ask that you refer to pages 9, 11, 13, 15 and 17, which outline the specifications for asphalt filler for brick pavements, together with the method of application. G. L. SCHOMBURG,

Paving Department, Standard Asphalt & Rubber Co., Chicago, Ill.

The following extracts from the booklet referred to will show the differences between the asphalts used for filler in ordinary brick pavements and in vertical fiber brick pavements, also the differences in methods of application, based on the experience of the company with which our correspondent is connected:

For ordinary repressed brick or block pavements, the following specifications are recommended:

The interstices, or joints, of the brick (or block) shall be completely filled with Sarco asphalt filler, or any asphalt filler equal thereto, which must conform to the following standard of quality:

(a) It shall contain not less than 98 per cent. pure bitumen soluble in carbon disulphide (CS_2).

(b) Of the total amount soluble in carbon disulphide (CS_2) 98½ per cent. shall be soluble in carbon tetrachloride (CCL_4).

(c) When tested with a No. 2 needle weighted with 200 grams operating for one minute at 32 degrees Fahrenheit, it shall have a penetration greater than twenty-five (Dow method).

(d) When tested with a No. 2 needle weighted with 200 grams operating for seconds at 115 degrees Fahrenheit, it shall have a penetration greater than eighty.

(e) When tested with a No. 2 needle weighted with 100 grams and operating for five seconds at 77 degrees Fahrenheit, it shall have a penetration between the limits of thirty-five and fifty.

(f) Its specific gravity at 60 degrees Fahrenheit shall be greater than .975 and less than unity.

(g) It shall have a melting point not lower than 225 degrees Fahrenheit.

The filler shall weigh not less than eight nor more than eight and one-half pounds per gallon at 60 degrees Fahrenheit. It shall remain ductile at all climatic temperatures to which it shall be subjected, shall be water-proof, acid-proof and impervious to street liquids. Shall adhere firmly to the brick (or block) and be pliable rather than rigid, thus providing for expansion, contraction and all traffic conditions.

The filler must be heated sufficiently to allow proper pouring or squeegeeing (about 400 degrees Fahrenheit), taken from the kettles in buckets and poured from pouring cans.

The contractor must be equipped with pouring cans especially designed for this purpose.

Before pouring the asphalt filler care should be taken to see that all bricks (or blocks) are in a bone-dry condition.

All joints at both sides and edges of the bricks (or blocks) must be filled completely by pouring or squeegeeing the material directly into and flush with the top. The material as poured shall be at a temperature of not less than 350 degrees Fahrenheit nor more than 400 degrees Fahrenheit. As the work progresses and while the material is still hot there shall be sprinkled over the entire surface a layer of clean, dry sand (preferably heated).

The filler is poured in the joints of the brick from specially prepared cans, which consist of a funnel-shaped receptacle, narrowed down to a tip at one end, furnished with a handle projecting from the other, and a valve-rod controlled by the operator for opening the delivery at the end tip.

The pouring is done by placing the tip in the joint of the brick, walking slowly backward, at the same time allowing the filler to flow so as to completely fill each joint. The tip rests in the joint and will therefore act as a guide, preventing the spilling of the material on the surface, provided reasonable care is taken.

For vertical-fiber brick pavements:

The asphalt filler used in the construction of a repressed brick or block pavement would not suffice for the vertical fiber brick, inasmuch as the asphalt filler is not only placed in the interstices of the brick, but is applied to the surface, and, consequently, must cope with different conditions.

The application of the asphalt filler for a vertical-fiber brick differs slightly from the method employed for a repressed brick or block.

The asphalt filler is heated in the same manner but is brought on to the work in open buckets and is poured on the surface of the brick in a semicircle with a dragging motion. Men equipped with iron squeegees, which are heated to a glow—and these squeegees must always be very hot—pull the asphalt filler toward them over the surface of the brick, leaving as little as possible on the surface, not to exceed an eighth of an inch.

A hill of sand is spread from gutter to gutter directly behind the men with the squeegees, and immediately after the filler is applied, and before it has had its initial set, the sand is pushed over the asphalt, allowing one-half of an inch of sand to remain on the surface. This sand will be gradually forced into the asphalt coating by traffic and will add to its stability.

The following asphalt filler specification is recommended for vertical-fiber brick:

The interstices of the brick, as well as the joints next to the curb, railroad tracks and around manholes or other street structures, shall be completely filled with an asphalt filler complying with the following requirements:

The asphalt filler shall be composed of asphalt containing at least 98 per cent. of bitumen soluble in carbon bisulphide. At least 98½ per cent. of the contained bitumen soluble in carbon bisulphide shall be soluble in cold carbon tetrachloride. The penetration shall be uniform in consistency and shall not vary more than seven and one-half points in penetration from the following standard:

No. 2 needle, 1 minute, 200 grams at 32 degrees Fahrenheit, 30.

No. 2 needle, 5 seconds, 100 grams at 77 degrees Fahrenheit, 40.

No. 2 needle, 5 seconds, 50 grams at 115 degrees Fahrenheit, 60.

The above filler shall be water-proof, shall adhere firmly to the brick both in the joints and on the surface, and shall remain ductile and pliable at all climatic temperatures to which it may be subjected. It shall not run in the joints during the hottest summer weather nor become hard or brittle when cold. The melting point shall be not less than 225 degrees Fahrenheit nor more than 275 degrees Fahrenheit. The brick shall be dry and the asphalt filler shall be applied at a temperature of not less than 375 degrees Fahrenheit nor more than 450 degrees Fahrenheit by means of hot squeegees especially adapted to the purpose. The joints shall provide sufficient hot material on the top surface to fully cover the etched or reticular surface with a thin coat of the hot asphalt.

A top dressing of one-half inch of coarse dry sand (preferably heated) shall be spread immediately after the filler is applied, and before it has had its initial set, and shall immediately be rolled with a roller weighing not less than three nor more than five tons until the sand is thoroly embedded in the asphalt filler. As soon as the sand has been thoroly ground into the top dressing of asphalt by traffic the surplus may then be swept clean.

Ordinances Regulating Street Excavating—Replacement by City.

The Editor of MUNICIPAL ENGINEERING:

Sir—In the January issue of Municipal Engineering, page 40, we find a letter asking for information as to latest improved ordinances regulating excavations and improvements made by gas companies, etc., together with the statement that the writer knows of no such ordinances and asking if any reader can furnish same.

We herewith attach copy of portions of the ordinance under which we are working relative to this subject and under which the street department of our city

backfills all excavations and replaces all pavement at the expense of any public utility company or other party requesting the cutting of such pavement. This ordinance works very satisfactorily with us and has relieved the city of the frequently disputed question of responsibility for settlement of pavement and as to whether same was caused by excavations thereunder, etc.

The city, doing all this work itself, keeps experienced men for such work, does its work thoroly and very seldom experiences any trouble over setttlements. Utility companies and others appreciate having the work done by such experienced men, thus relieving them of any responsibility in connection therewith.

In our annual report for 1914 you will find further reference to this matter, together with other information which may be of interest in this connection.

CHAS. R. CASE,
Supt. of Streets and Sewers.
Seattle, Wash.

The portions of Ordinance 25150 relating to backfilling and replacing pavement cut read as follows:

"Section 5. That in all cases where the city of Seattle shall have acquired assignments in whole or in part of any such maintenance contract, the superintendent of streets, under the direction of the board of public works, shall make all repairs in the pavements necessitated by reason of cuts and openings made therein in laying or relaying any gas, sewer or other pipes or conduits by persons thereunto authorized by permit. Before any such permit shall be issued for the breaking up or opening of any pavements, there shall be deposited by the applicant in the guaranty deposit fund a sum of money equal to $2.00 per cubic yard for each yard of earth to be used in the backfilling of any such opening, $5.00 for the first square yard of pavement necessary to be broken up and $3.00 per square yard for each yard of pavement after the first yard so to be broken. Upon the laying down of said gas pipe, sewer pipe, water main or other pipe or conduit in accordance with such permit, the superintendent of streets shall immediately take charge of the trench in which such pipe or conduit shall have been laid and shall proceed to refill same and repair the pavement thereon.. Upon the completion of said work by the superintendent of streets, a verified statement of the cost thereof shall be furnished to the city treasurer and one copy of which shall be filed with the city comptroller. (Upon the completion of such work by the superintendent of streets, he shall certify such fact to both the city treasurer and the applicant, with an itemized statement of the cost thereof.) The city treasurer shall thereupon, upon the surrender of said original guaranty deposit voucher, without further ordinance or order, pay to said applicant the balance that may be due as excess on said deposit. In computing the charge to be made for such work, there shall be added, by the streets and sewers department, the sum of 10 per cent. of the actual cost of such labor.

"Section 6. Instead of making deposits in advance for each and every cut or opening to be made, as provided for in Section 5 hereof, and as an alternative thereto, any person, company or corporation desiring so to do may deposit with the city treasurer from time to time to the credit of the department of streets and sewers the sum of $500 and shall replace said sum from time to time whenever such person, company or corporation shall have been notified by the street and sewer department that the amount of such deposit remaining shall have been reduced to the sum of $50 or less. Such deposits shall be used in the same manner as set forth in Section 5 hereof."

From the annual report the following facts are gathered:

"The year's average shows a cost of 93.3 cents per square yard for repairs to cuts and worn holes in asphalt pavements, and $1.9167 for brick pavements."

"Side-sewer contractors have heretofore been required to put up cash deposits for backfilling and replanking or repairing cuts made in streets. We have eliminated this method and are holding bondsmen of such contractors liable for all such bills.

"In the case of the larger building contractors, instead of each department requiring a cash deposit to protect itself against unpaid bills for work done or damage to city utilities, we have encouraged the filing of a bond covering all these matters, we notifying other departments of the filing of such bond and their protection thereunder.

"Deposits are still necessarily required of smaller contractors using streets as a protection against damage to same and a cleanup upon completion."

Some idea of amount of work may be derived from the following figures taken from the numerical reports of work done, cost and bills:

The amount received from contractors and others for repairs to asphalt pavements was....	$4,249.09
General bills for repairing and cleaning streets, work done and supplies furnished, 11 months, to Dec. 1, 1914.....	15,111.43
General bills for repairing and cleaning sewers	1,757.58
Interdepartment bills for cleaning and repairing streets.....	4,467.14

Inter-department bills for cleaning and repairing sewers.....	61.78
Amounts received from contractors and others for work done by the department for them were as follows in maintenance:	
Departments	17,781.63
Planked streets.....	1,143.95
Dirt streets	652.99
Sidewalks	1,817.77
Sewers and drains.....	1,819.36
The inspection division released guaranty deposits for use of streets amounting to.....	15,530.75
Permits issued to franchise holders for street work.....	235
Sewer extensions inspected.....	309
Orders to backfill sewers.....	179
Permits issued for sewers.....	1,948
Permits issued to repair sewers.	52

Sir—In your issue of January, 1915, an article appeared relative to "Ordinances Regulating Street Excavations." I am sending you a copy of an ordinance regulating these matters in our city and wish to say that this ordinance has given good satisfaction here, both to the gas and water companies and plumbers, as well as to the public.

ELMO A. FUNK,
City Engineer, Anderson, Ind.

Ordinance No. 811.

An ordinance to regulate the digging of trenches and other excavations in the public streets, alleys and sidewalks of the city of Anderson, Indiana, and providing penalties for its violation.

Section 1. Be it ordained by the common council of the city of Anderson, Indiana, that hereafter it shall be unlawful for any person, firm, or corporation to dig any trench or to make any excavation of any kind whatsoever in any of the public streets, alleys, or sidewalks of the city of Anderson, Indiana, without first obtaining a written permit from the city engineer to do so.

Section 2. For the purpose of obtaining such written permit the person, firm or corporation desiring the same shall file with said city engineer a statement in writing to be signed by such applicant and setting forth the time when such excavation is to be made, the place where same is to be made and the purposes thereof and the approximate dimensions of the same.

Section 3. At the time of securing such written permit from the city engineer and before the same shall be issued, the party applying for the same shall pay to the city controller of said city a sum in cash sufficient to pay and defray the expenses of refilling such trench or excavation so as to leave such street, alley or sidewalk in the condition that same was in before such trench or excavation was made. Such estimate shall be made by the city engineer and the amount estimated therefore shall be paid by the applicant to the city controller, and his receipt therefore shall be presented to the city engineer, who shall then issue such permit. As soon as such trench or excavation is ready to be refilled the person, firm or corporation to whom such permit was issued shall immediately notify the city engineer, who shall cause the same to be refilled and resurfaced by street committee of said city under the direction and supervision of said city engineer. That portion of said deposit not required to refill such trench or excavation shall be returned by city controller to person paying same.

Section 4. Anyone violating provisions of this ordinance shall be fined in any sum not less than $10.00 nor more than $25.00. This ordinance shall be in force and effect from and after its passage and publication as required by law.

Disposal of Garbage and Refuse in Seattle.

The Editor of MUNICIPAL ENGINEERING:

Sir—Your communication addressed to Mr. A. H. Dimock, city engineer, regarding disposal of waste has been referred to this department for reply.

We are at present disposing of our garbage and waste by making sanitary fills, or at least of all but sixty-five tons per day, which is incinerated. This is light material and such as would be difficult to dispose of at the present fills on account of their location.

This method of filling works very satisfactorily in this climate, but I believe it is necessary to include all waste materials, as ashes, boxes, tin cans, etc. These all assist oxygenation and nitrification. I do not believe pure garbage can be handled in this way.

We also find that it is best to keep as little of the face of the fill exposed as possible. It is always best to keep a man constantly on the job, whose duty it is to rake down to the bottom of the fill all boxes, rough materials, etc., thus leaving the ashes to form a covering on top. When this is not sufficient we cover with a layer of earth about five inches thick.

The success lies in the proper mixture of waste materials, and next the fill must be properly covered to protect from flies. Chemicals can also be used to protect same. This covering also prevents the slight sour odor of fresh garbage, and, by keeping out the sunlight, at the same time encouraging bacterial growth by increasing the warmth inside of fill. People residing within one hundred feet of

these fills make no complaint, but the public has to be educated when you first adopt this method. We aim to fill city property, as ravines, swampy land or docks on the lake or salt water front.

Enclosed find copy of our laboratory findings, which will show that the process is simply one of slow incineration by nature instead of the expensive method of burning by incinerators, and at the same time will help to prove that there is nothing detrimental to public health in these fills.

We have eleven fills distributed over our city, thus making short hauls, and these are taken care of by eleven laborers, disposing of approximately three hundred and fifty tons per day by this method alone, while one incinerator with about an equal pay roll will only dispose of sixty to seventy-five tons per day, running twenty-four hours. A fill increases the value of property, while the refuse from our incinerator has to be hauled away at an added cost.

J. S. McBride,
Seattle, Wash.

Following is the chemist's report referred to:

Results of chemical examination of samples of "garbage borings" submitted to this laboratory for examination:

Three months old:

Sample Number	Moisture, Per Cent.	Organic Matter (Unburned Coal), Per Cent.
1.....	26.17	16.26
2.....	24.29	18.79
7.....	29.86	10.02

The samples as submitted consist almost entirely of the ash of coal carrying considerable moisture and some organic matter in the shape of unburned coal.

The samples carry only traces of decomposing or fermentable organic matter.

Six to eight months old:

3.....	29.40	8.79
4.....	24.90	7.80
5.....	32.46	9.10
6.....	33.03	10.02

One year old:

8.....	15.00	12.41

Eighteen months old:

9.....	8.33	7.32

The organic matter in the above samples consists almost entirely of carbon or unburned coal.

The samples contain very little of a fermentable or decomposing nature.

The decomposing matter in the above samples would in all probability not amount to over 0.1 per cent.

A. Jacobson,
City Chemist.

Graphic Methods for Presenting Facts

The science of presenting facts to the eye so that they will impress the mind of the non-scientific observer more clearly, has developed rapidly of late years. For many years this method of making comparisons was open only to the trained mathematician, but now the mathematics are all taken out of it as to the reader or observer and the making of the graphical charts is largely reduced to rule.

There are suitable and unsuitable methods to use, however, and the clearness of the exposition of the subject illustrated depends upon the proper selection of the method. Then, too, it is quite easy to give wrong impressions by improper manipulation of graphical methods, even if the exact facts and only the exact facts are shown.

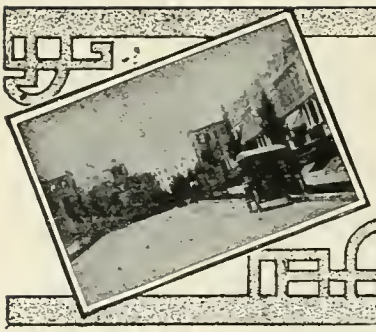
The science, as it has been developed today, is fully set forth in Willard C. Brinton's book on "Graphic Methods for Presenting Facts," which fully explains the uses of various simple graphical devices and the misuses often made of them.

The principal devices described are the horizontal bar, the circle and sectors, separate bars, horizontal or vertical, totaling 100 per cent., charts giving numerous subdivisions, organization charts, routing charts.

Simple comparisons of quantities of one, two or three dimensions are made and various methods of making such comparisons are compared and contrasted, showing when they are suitable and when not. The plotting of curves to show continuing processes or provisions of facts, with full discussions of the proper units to use in making the drawings, occupies several chapters. The explanations are so full and clear that the unmathematical reader can learn to understand the showings of the curves if not to construct them himself. The mathematical reader has a full treatise on the tools thus put into his hands which should make him expert in showing facts by graphical methods and in making true comparisons

Maps and varieties of shading to show various kinds of information are fully described and illustrated.

General methods for collecting and tabulating data in order to get them into understandable form, preparation of charts, instructions to engravers in reproducing them for publication, making of titles, statement of scales and of relations of them to each other; in short, all the details from the selection of facts to collect to the publication of those facts in printed form are given in full detail and clearly so that any one wishing to avail himself of the graphical methods of presenting facts will find full instructions for all steps in the process.



ROADS AND PAVEMENTS

Tests vs. Inspection of Treatment of Creosoted Wood Paving Blocks.

A Paper by Frank W. Cherrington, Engineer for Jennison-Wright Co., Toledo, Ohio, before the American Wood Preservers' Association.

Is the collection and analysis of creosote oil, extracted from creosoted wood paving blocks after treatment, a reliable calculation as to the initial quantity actually injected inside the blocks, during the process of treatment?

The desired degree of accuracy, relating to the average quantity of injected creosote oil per cubic foot of timber, cannot be reached by the laboratory extraction and analysis of creosote oil, after its injection into wood.

Owing to the remarkable variation in the structure of wood it is only possible to determine accurately the average quantity of creosote oil injected per cubic foot of timber, by close observations of the proper treating gages and automatic feeding devices at the creosoting plant during the actual process of treatment.

The composition of the timber is of so complex a nature that scarcely two wood paving blocks are identical in structure, even when cut from opposite ends of the same plank of average commercial length. This is true, regardless of the most careful commercial specification as to lumber, limiting the percentage of heart-wood, number of annual rings to the inch, etc. Therefore, altho treated under the same temperature and same pressure, scarcely two wood paving blocks will have the same degree of penetration or absorption.

The reasons for the variation in the structure of wood blocks sawed from the same species of wood, whether taken from the same tree, or from widely separated growths, are difficult to explain, but a few of the more obvious reasons are here cited.

It is very evident that some of the blocks are necessarily manufactured from timber coming from the heart of the tree and some from the exterior portions of the tree. The even dry weight of sapwood is often but two-thirds that of the heart-wood. A cross section of a truee cut from its base will be of an entirely different structure from the cross section cut from the middle or top. Timber growing on the side of a hill will be different from that growing on high or low ground. Some trees will grow at the edge of the forest and others in the interior. A piece of timber cut from the north side of a tree will show a different structure from that cut from the south side. A rapidly growing tree will have a different structure than that of a slow growth timfer of the same species. Thus it is seen that environment is largely responsible for the complexities in the wood structure of a tree.

A quotation from Bulletin 101 of the Forest Service, United States Department of Agriculture, relating to "The Relative Resistance of Various Conifers to Injection with Creosote," follows:

"It is very difficult and sometimes apparently impossible to secure uniform treatments of wood with preservatives. If, for example, an average treatment is given of ten pounds of creosote per cubic foot, some pieces of wood in a charge will take twice the average amount, while others will receive less than half of it."

An average carload of creosoted wood paving blocks will contain approximately 300 square yards, or 15,000 individual blocks. The chemist in making analysis after the blocks are treated and have arrived on the work, selects perhaps a dozen, but rarely two dozen, blocks from the car at random. The creosote oil is then extracted and analyzed as to both quantity and quality, and the result accepted as the average oil content per cubic foot in the 14,976 other blocks. If as many as two dozen blocks are selected out of the entire car as samples, they will represent but 0.16 of 1 per cent. of the total number of blocks in the car.

The government bulletin above referred to also states that "in general long leaf

pine was found to be erratic in its penetration and absorption of creosote."

The above citation from the government, and the listing of but a few of the factors affecting the structure of wood, prove the futility of selecting a few wood paving blocks for analysis, after the injection of the oil, as representative of the average penetration and quantity of oil that may be secured on the entire car. The blocks selected for analysis may be all heart or all sap, with large or small quantities of resin, etc., and the chance of a wide deviation from the true average is great.

The final result obtained from a laboratory analysis is liable to be in error. The human element, volatility of the creosote oil, difficulty in separating the injected creosote oil from the natural resin, impossibility of extracting all of the injected oil, etc., etc., all tend to reduce the precision of the result. The possibility of an error in laboratory extraction and analysis, combined with the variation of the wood structure, doubles the chance for inaccuracy and detracts from a precise estimation of the average amount of creosote oil initially injected into the wood.

Records showing the average quantity of creosote oil actually injected into the wood blocks at the plant during the treatment, when compared with the results showing the amount of oil extracted by laboratory analysis from selected samples, representing an exceedingly small proportion of the entire number of blocks treated, will naturally show a decided variation.

When laboratory analyses are accepted by the consumer as absolutely conclusive, regardless of whether or not an inspector has been present to check the actual injection of the oil at the plant, creosoted wood blocks are often rejected, when the manufacturer has conscientiously and closely followed the required specification.

Directly bearing on this subject, is the following excerpt taken from a report by Wm. W. Marr, assistant engineer of streets, Board of Local Improvements, Chicago, Ill., entitled "Repaving the 'Loop' District in Chicago with Creosoted Wood Blocks," which, of course, anticipates a proper selection of the timber, oil and treatment, in accordance with good practice:

"Many blocks, on being split for the purpose of making mitres or closures, show white on the inside and appear to have received very little treatment. This is a cause of a great deal of complaint from those who are not familiar with the reason for blocks having this appearance. As a very great number of blocks are treated at one time, it is not reasonable to suppose that a few blocks could have received a less pressure and treatment than the balance of the blocks received; so it can safely be assumed that the blocks which do not show so great a penetration as the rest are simply incapable of taking the oil on account of their pores being already filled with resin. Blocks of this sort have never given any trouble and are consequently never rejected."

Modern creosoting methods employ the treatment at one time of some thirty thousand (30,000) individual, and very different paving blocks. These are placed in the same creosoting cylinder and subjected to the same temperature and same pressure. It is impossible to give each block an individual treatment, and since blocks of varying structure must be treated collectively, it is but consistent to insist that an extremely small proportion of the whole, selected at random for analysis, cannot be conclusively indicative of the average absorption secured by the treating plant engineer on the entire charge.

Supply and Use of Water in Concrete Road Building

From a Paper by C. D. Franks Before the Indiana Engineering Society.

It is often the case that a concrete roadway or other hard surfaced road is to be placed upon an old roadway, when the new road is wider than the old roadway has been. Where such a condition exists it will be necessary to loosen thoroly the old roadway for quite a distance below the desired surface of the finished sub-grade, this distance to depend upon soil and other local conditions. The entire fill should then be made and compacted uniformly, the object being to provide a sub-base of equal bearing power thruout, for when one part of the foundation of a hard road surface is less apt to settle than another, it is impossible to do away with cracking. A special example may be cited in the case of a hard surfaced road which is to be laid at a greater elevation than the old roadway, where the old roadway was on a considerable fill. As the new roadway will rest upon a fill deeper than the old, the width of the fill at the bottom will be proportionately greater. To obtain a uniform bearing surface, therefore, the material in the old fill should be spread out uniformly in a layer from one side of the new slope to the other and the rest of the fill be placed on top of it. The greatest care is necessary in building any fill of greater depth than two feet, so as to have it in a thoroly compacted state before any hard pavement is laid upon it. If absolutely necessary to place the roadway soon after this fill is made, the material should be placed in layers not

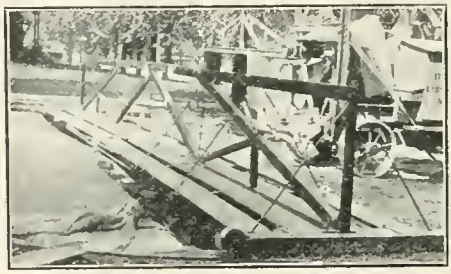
to exceed one foot in thickness, and should be thoroly rolled before succeeding layers are placed. If soil conditions permit, it will be well to settle this fill with water in addition to or instead of rolling. By far the better practice would be to build the fill in the fall of the year previous to that in which the roadway itself will be laid. In this manner many unnecessary cracks can be avoided.

There is a simply made tool which can be used to determine the slope of material in a fill. It consists of three boards—one horizontal, one vertical and one inclined, making an angle with the horizontal piece equal to the required slope of the material. From the horizontal board a plumb-bob is hung and vertically below it on the inclined board a mark is made. This gage is placed with the inclined board along the slope. If the side surface of the fill corresponds to the required slope, the plumb-bob will hang directly over the mark on the inclined board.

It should hardly be necessary to state that it is extremely bad practice to make a fill with frozen materials, yet one or two cases of this kind have come to my attention. When frozen material in a fill thaws it compacts greatly under its own weight and the surface of the fill settles considerably; invariably enough so that no hard surfaced road can stand upon it without cracking.

It sometimes becomes necessary, when grading, to set a stake on one side of the roadway at the same level as that on the other side, when a level is not at hand. This can be very simply accomplished by completely filling a piece of hose with water. By holding one end of the hose so that the water showing in it is just level with the top of the stake of known elevation, and setting the stake on the opposite side of the road at the elevation of the water at that end, you can be sure that the second stake is at the same elevation as the first, the hose acting as a siphon in case the roadway between the stakes is higher than the stakes.

CONCRETE MIXER *which must be supplied with water regularly, and in sufficient quantity.*



The water supply for the construction of a concrete road and pavements is always a problem, if handled economically and satisfactorily The necessity of an adequate supply may be surmised from the fact that the sprinkling of the sub-grade before concrete is laid, the mixing of the concrete and the sprinkling of the finished concrete surface for curing, will require on an average of 13,000 gallons per day, when 500 square yards of concrete pavement are laid. In rainy weather or in the fall of the year the sprinkling may be unnecessary and this amount of water may be materially reduced, but it is unsafe to provide for any smaller amount than 25 to 30 gallons per square yard of concrete laid in the summer months, for an inadequate supply will materially hamper the work, delay the job and increase the contractor's cost.

The volume of water required at the mixer is the same whatever the size of the supply pipe may be. In order to supply the same amount of water the velocity in a small pipe must be greater than in a larger one. But friction increases as the square of the velocity, and therefore the loss of head in a small pipe is much greater than in a larger one. In practice it is rarely found advisable to use less than a 2-inch pipe line to supply water to a concrete road or pavement job, and no connections smaller than 2 inches should be used. Where two sizes of pipe are used, the contractor may have laid his smaller pipe nearest the pump or source of supply before the larger size pipe is secured. He has in one or two instances considered it necessary to place the larger size nearest the supply. This necessitates, of course, that the smaller pipe be carried ahead to the end of the larger pipe. which may be in some instances as much as a mile or two in length. This is unnecessary, as the total friction will be the same whether the larger or the smaller pipe is nearest the supply, tho the smaller pipe may be eliminated sooner from the line if it is laid farther from the source.

It frequently becomes necessary to take a section of pipe from the pipe line to remove an obstruction or for another purpose. For this reason unions which will allow one pipe to turn without turning the one next to it should be placed at distances not to exceed 500 feet apart. Otherwise the entire pipe line must be turned to remove one section, necessitating the use of unreasonable force. T's and taps should be placed in the line not farther apart than twice the length of hose which will be used to connect the water pipe with the mixer. This hose should be at least one inch in size to reduce friction and should preferably be

LAYING CURB AND GUTTER *with water supply to concrete mixer furnished in barrels, quantity required being much less than for pavement.*

short for the same reason, so that it will be well to space the T's and taps not farther than 200 feet apart. Pipe for the water line should be procured in as great lengths as can be economically handled, to lessen the labor of connecting.

When the water is taken from a poor or other natural source, the intake should be protected so that sticks and other foreign matter will not be drawn into the pump and pipe line, where they will cause trouble. When the water supply is taken from a city main it will sometimes be advisable to use a booster pump to obtain a sufficient head for the requirements of the job. In many cases it is possible, when constructing pavements in cities or towns, to connect directly by means of a suitable hose to water hydrants. However, it will be found more economical in a great many cases to be provided with a line of pipe, in order to insure at all times the proper delivery and amount of water required to carry on the work satisfactorily.

Some sort of relief valve must be used in the pipe line so as to prevent the breaking of the pipe or the blowing out of the cylinder head in the pump when it is running but no water is being used. Spring relief valves have been used with success, but a simple arrangement may be used to take their place. At one of the T's previously placed in the pipe line near the mixer, insert one or more lengths of pipe vertically upward. The top end of this pipe will be open and this arrangement will act as a relief valve. If the outflow of water at the mixer is stopped, the pump, instead of exerting pressure against the water confined in the pipe, can raise the height of water in this improvised standpipe and any excess may be allowed to flow thru the upper open end of pipe. This arrangement acts as a relief valve and also assists in procuring a uniform pressure of water at the mixer at all times. This is always desirable and materially helps in obtaining a uniform consistency of concrete delivered by the mixer. This standpipe should be moved frequently so as to be always close to the mixer.

Like all other things, the pipe line will expand and contract with changes in temperature, and unless some provision is made for this expansion and contraction, rupture is apt to occur. For this reason, expansion joints of some kind must be placed in the pipe, preferably at distances not to exceed 2,000 feet. The copper expansion joint is a standard fitting and is often used for this purpose, or a satisfactory expansion joint may be formed by three sets of fittings, consisting of two elbows and a nipple, so placed as to make a "V" in the pipe line. Another satisfactory method is to offset the end of one pipe from the other slightly—say a distance of six inches. These two ends should then be connected with a rubber hose. Connections of this hose with the pipe must be tightly made in order to prevent leaks, and the hose should be of a size at least equal to that of the pipe to

reduce friction, which will be naturally greater where the water is forced thru any bend. Sufficient hose should be used to provide for a movement in the pipe of six inches.

The character of the sub-grade for roads or pavements is sometimes such that sprinkling immediately before placing the concrete results in a muddiness which is detrimental to the work. At the same time, if concrete is placed upon such a sub-grade without sprinkling, the thin mortar will be withdrawn from the concrete and thus prevent its hardening or weaken it. Therefore, it may sometimes be necessary thoroly to sprinkle the sub-grade before the aggregates are placed upon it, so that it will be moist but not muddy when concrete is deposited. Necessity for this early sprinkling can only be determined by an investigation and possible experiments with the particular sub-grade in question.

One of the things which has required the greatest attention in the past is the water supply to the drum of the mixer, so as to obtain a uniform consistency of the concrete. No method should be used which does not automatically supply each batch of materials with the proper amount of water. This makes the use of a measuring device for water, which is positive and quickly adjustable, a necessity. Contractors who are considering the purchase of a mixer, or engineers who are passing upon a mixer to be used upon concrete road work under their supervision, should thoroly investigate this most important part of the equipment—the automatic measuring tank for water.

One of the most difficult things to provide for in specifications is a thoro mixing, because of the different shapes and positions of the mixing drum and blades, as well as the speeds at which the drums revolve on the different makes of mixers. The only satisfactory way to write a specification that will cover all types of mixers is to specify two minimums; one the minimum number of revolutions per minute and the other the minimum time of mixing a batch. A recent device for automatically recording the number of revolutions per batch was on exhibition at the sixth annual good road show, held in Chicago during December, 1914. An indicator was placed on the side of the mixer which could be set to the specified number of revolutions. When the unmixed materials were placed in the drum, this indicator automatically recorded the revolutions of the mixer and at the proper number a bell would ring, indicating to the man at the discharge end that the batch was ready to be removed from the drum. This device is a great step forward in the proper mixing of concrete, for, by determining the r.p.m. of the drum, setting the indicator properly and following the signal given by it, thoro mixing is insured.

The Utilization of Short-Term Convicts for Highway Work in Georgia.

From a Paper by James Leland Stanford before the American Association for the Advancement of Science.

To secure accurate data a questionaire was submitted to persons actually engaged in working misdemeanants on the roads in every county in Georgia. The results obtained are presented in a condensed form in this preliminary report. They give the viewpoint of citizens and officials in Georgia and, being uncolored by outside influence, are of great value.

The State Prison Commission reports that practically all of the misdemeanant and felony convicts, with the exception of the women and those in poor health, are employed in some phase of highway work, 2,441 misdemeanant and 2,740 felony convicts being worked by 124 counties during 1914.

Cost of Equipment for Road Gang.

	Camp Equipment.	One Unit.	Two Units.	Four Units.	Six Units.
1.	Winter barracks, including guard room	$140	$200	$240	$300
2.	Cook room	25	25	25	25
3.	Large range, cooking utensils and dishes	125	125	130	150
4.	Hospital and furnishings	50	50	75	75
5.	Tents for summer camps	50	70	140	200
6.	Stable sheds	60	75	125	170
7.	Bath house, equipped to wash clothes	25	25	30	40
8.	Commissary tent and fixtures	25	30	35	40
		$500	$600	$800	$1,000

Each unit is composed of one guard and fifteen convicts.

Comparison of Increased Cost of Dividing Gangs.

Camp Equipment.	One.	Two.	Four	Six.
Cost of separate 1-unit gangs	$500	$1,000	$2,000	$3,000
Cost of separate 2-unit gangs	600	1,200	2,400	3,600
Cost of separate 4-unit gangs	800	1,600	3,200	4,800
Cost of separate 6-unit gangs	1,000	2,000	4,000	6,000

Road Machinery and Road Working Equipment

For a 2-unit gang, earth and sand clay construction:

1.	Large 6-horse grader	$255.00
2.	Two-horse grader	110.00
3.	Large rock or rooter plow	35.00
4.	Rock plow	20.00
5.	Five drag scrapes	36.00
6.	Four wheel scrapes	240.00
7.	Four 2-horse wagons	260.00
8.	Ten large mules	2,250.00
9.	Five sets of double harness.	100.00
10.	Hammers, shovels, picks and axes	74.00
	Total	$3,350.00

Size of a Road Gang Under Ordinary Conditions.

Regardless of the kind of work undertaken by a convict gang the annual interest on the first cost and depreciation of the equipment and the annual expense of maintaining the convicts must be considered. The economical solution is to so adjust the size of road gang as to render the sum of these factors a mimimnm.

Cost of Maintenance Per Convict Per Day.

	One Unit.	Two Units.	Four Units.	Six Units.
1 Physician	0.111	0.055	0.027	0.019
1 Warden	0.132	0.066	0.066	0.022
1 Day guard, per unit	0.066	0.066	0.066	0.066
1 Night guard, per camp	0.066	0.033	0.016	0.011
Food	0.250A	0.230B	0.204C	0.168D
Clothing	0.106	0.100	0.095	0.091
Depreciation	0.075	0.028	0.025	0.021
Interest on first cost of all kinds of equipment	0.058	0.022	0.020	0.016
Total cost per day	0.865	0.600	0.519	0.414
Actual practice plus interest.	0.850E	0.559B	0.446C	0.395E

Based on salaries for month: physician $50.00, warden $60.00, each guard $30.00, rate of interest, 6 per cent.

(A) F. F. Hill, Homer, Ga.
(B) J. C. Redman, Butts Co.
(C) E. H. Myres, Ware Co.
(D) V. O. Morgan, DeKalb Co.
(E) Average of several similar reports.

According to reports received and actual experience, which may be said to have passed the experimental stage, a guard can most economically and advantageously handle fifteen men. Fifteen men per guard under ordinary local conditions in the Southern Eastern states has, therefore been chosen as a unit. And it is suggested to the engineer, who is planning a county gang, to make the gang some multiple of fifteen, if he would secure the greatest efficiency per guard and the greatest efficiency per gang. The size of a gang varies in numbers according to the wealth and population of the county, as each county works its own misdemeanants. In exceptional instances only should a road gang be less than two units or thirty men, as the expense per man has been found to increase rapidly when the number is smaller.

The number of units composing a gang should be proportionately determined by such factors as the expense per man; mileage of roads to be constructed and repaired; the character of the work to be done; the class of men in the gang; and the equipment provided.

One engineer reports that in heavy cuts and fills gangs work efficiently up to seven units. For ordinary construction work on county roads, some distance from a base of supplies, experience has proved it more economical to divide a gang when it exceeds appreciably six units.

The expense per man both as to food and guarding at night increases rapidly as the number of men in a gang falls below thirty and decreases just as rapidly as the gang increases by units up to a certain limit. One night guard can handle a camp of ninety convicts quite easily, since the day guards sleep nearby and are ready to give him assistance at anytime. Moreover, men who work on the roads all day hardly need a guard at night. When a four-unit camp is divided into two camps of two units each, an extra night guard and an additional warden must be employed, since the law requires a warden to each camp.

The guards act as road foremen, hence the expense of employing foremen is obviated and balanced by guard hire. The guards should be hired at a stipulated amount and their wages gradually raised as they become more efficient foremen.

In a great many instances it has been found economical to use certain mechanical appliances as labor-saving devices. Mules are generally used for traction in the construction of sand-clay roads, because they can be utilized in places which would make other forms of motive power impracticable.

As yet very little evidence has been presented as to the economic use of mules for road work, and a policy will merely be outlined, which may be considerably modified before a conclusion is reached in the matter. Not only the use of mules, but other forms of traction will each be considered in the final report on this subject. It is evident that the cost of hauling on the ten-mile basis bears a fixed relation to the cost of running a convict camp economically.

The efficiency of a gang in constructing sand-clay roads depends upon the number of mules per gang; within certain limits, "one mule per man is best usage" and secures the greatest amount of efficiency per gang. The mules are usually worked in teams and are hitched to the various appliances used in road work. A great deal of hard labor and valuable time is saved thereby.

When the number of mules drops appreciably below half the number of convicts composing a gang, the efficiency of the gang will become so low that convict labor ceases to be economical and the county will lose money on the job.

When the number of mules appreciably exceeds the number of convicts composing the gang, the number of trusties and the mules operating the machines will be exhausted. It is not a good policy to hire free labor to operate the machines, because of the increased expense and the likelihood of friction with the convicts.

Charleroi Paving Bonds Sold

Twenty-five thousand dollars worth of the $75,000 issue of bonds, authorized at the recent election in Charleroi, Pa., have been sold by Charleroi council to the Holmes-Wardrope Company, of New York City. The bonds are to bear 4½ per cent. and are to mature in thirty years. Together with the selling of the $25,000 bonds, an option was given on the remaining $50,000, to hold until April of this year, at the same figure.

Third street will be the first street given attention. The boro engineering corps is requested by the council to prepare a grade and to arrange all preliminaries for the paving of the street during the winter, so that the contract can be awarded and the work of paving actually started at the earliest possible moment next spring.

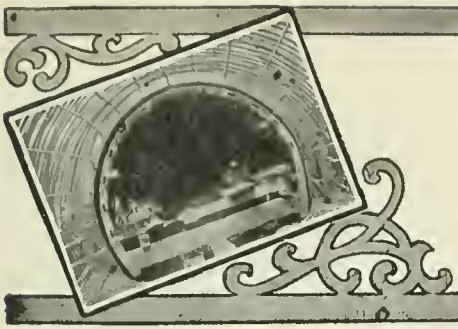
This sale shows that there is full confidence in municipal bonds and that there is money ready to invest in long-time municipal bonds at reasonable rates.

The Boro of Charleroi is enabled by this sale to take advantage of the present prices for materials and thus to obtain lower figures on contracts let at this time than will be available later in the year. The only exercise of judgment required of the contractor in bidding at this time is as to the future price of labor.

Increased Popularity of Municipal Bonds

One of the safest and wisest forms of investment today is that of municipal bonds. The average investor is probably less familiar with this class of securities than with corporation bonds, because in the past the relatively smaller income obtainable on them has led to a broader investigation of, and a more popular investment in, those securities paying the higher rate of interest. Their greater safety, however, has never been disputed, but been amply confirmed by the higher price levels which they have always enjoyed.

In recent years increasing attention has been given to this form of security by private investors, whereas formerly the markets for such bonds has been principally confined to savings banks, insurance companies and trust estates. The explanation for this was in many instances individual prejudice, and, also, as previously stated, because the rate of income had been less than that which it was possible to obtain from corporation bonds. In contrast with the present timidity about purchases of corporation securities there is a conspicuous feeling of confidence toward municipal bonds. About a year ago marked the beginning of a new and favorable sentiment toward them, occasioned principally by the passing of the income tax provision in the new tariff law. This law, exempting municipals from the income tax, focused the attention of investors upon the merits of municipal securities, and has resulted, not only in a broader market for them, but many holders of corporation stocks and bonds have been disposing of some part of those holdings in favor of public, tax-exempt bonds.



SANITATION

Inoffensive Sewage Disposal

By Rudolph Hering before Section D of the American Association for the Advancement of Science.

SEWAGE is dirty water and contains very roughly one part of dead organic matter and one part of mineral matter to between one thousand and five thousand parts of water. It is only the organic matter which concerns us here, some of which is unstable, breaks down quickly and may putrefy within a day, such as certain animal and vegetable liquids, and some is stable and decomposes very slowly, such as hair, wood fiber, epidermis, cartilage and the like. The unstable matter alone usually causes all the nuisance arising from sewage. It has but a slight resistance to decomposition. It first absorbs oxygen with avidity to form more stable compounds; these have no offensive odor of themselves nor do they produce gases with foul odors. Then, when the conditions have become such that oxygen for absorption is no longer available in the medium holding the unstable matter, other chemical processes become active, producing chiefly hydrogen compounds. Among the latter we have those which produce foul smelling gases and others which do not.

In view of these facts and in order to prevent offensive consequences, the practical engineer is obliged to place the sewage from first to last under conditions that permit of its being collected and carried quickly and completely from the points of origin to those of final disposal, and delivered at the latter points before the available oxygen in the sewage water can be exhausted. He is also obliged to provide means to facilitate decomposition by contact with oxygen, so far as practicable, and in its absence by such combinations of hydrogen as will produce no offensive odors.

All of the processes of sewage decomposition are accomplished chiefly by the presence of certain bacteria, which in their activity produce gases, some of which are offensive and some are not. We are here concerned only with those ways and means which will avoid the evolution of offensive gases.

Let us first consider the works for collection and delivery of the sewage with respect to achieving these desired results.

Our wash and bath rooms, toilets, kitchens, laundries, etc., are now supplied with fixtures in such a manner that offensiveness can be entirely excluded. This is done simply by giving them forms and surfaces upon which the dirty water can flow away quickly, no solid particles remain on the surfaces and a final flushing with clean water will restore the receptacles to their condition before use.

¶ VENTILATION *of house connections and free and rapid flow of sewage in them are essentials.*

The pipes carrying into the sewers the sewage thus generated should likewise carry it away quickly and completely. The means for accomplishing this are, first, smooth and evenly curved and jointed pipes, and, secondly, good currents of air circulation. The former prevents catching, retention and consequent putrefaction of solid particles, the latter tends to clean up the exposed surfaces which are otherwise usually covered with slimy growths. This air circulation is automatically established by providing openings to the sewer from the street surfaces, and openings to the house pipes above the roofs of buildings.

There was formerly strong opposition, particularly in England, to street sewer air passing up thru the house pipes to the roof. It was feared that street sewer air might enter rooms thru imperfect pipes or thru the fixtures if their traps were not in order. This opposition is still generally maintained. On the European continent and in many American cities,

the ventilation of street sewers thru house pipes has, however, been found very advantageous. The house pipes are kept much cleaner, the slimy coating is largely removed and the escaping air above the roofs is less odorous than when the house pipes are trapped at the bottom against the street sewer. A careful examination made in this country proved that the escaping air from house pipes contains practically no disease germs or other bacteria.

After the house sewage enters the street sewers it should be kept flowing without any interruption. This result is readily attained if the sewers are designed and built with reference to this end. The surfaces again should be smooth. Vitrified clay pipes, used for small sewers more than any other kind in this country, have the smoothest surfaces. Yet the inevitable projections at the joints, due to the manufacture of the pipes, reduce this advantage to some extent. In practice, therefore, the pipes are laid so that there is no projection at the bottom, upon which the sewage flows, and which would retain solid matter, but all of the projections are at the top. Cement pipes can be made almost as smooth as vitrified pipe and have no projection at the joints. Concrete sewers have the same latter characteristics. Brick sewers furnish the roughest surface, even if the joints are carefully made and the bricks are of the best. With good flushing and brushing down at proper intervals even brick sewers may be kept in such a condition as to entirely prevent offensive odors from generating therein.

Other important elements as regards odor production are the junctions of several sewers. They must always be made so that the sections above them are gradually and not suddenly merged into the sections below them, which construction prevents eddies and deposits resulting in putrefaction and odors.

¶ VENTILATION *of sewers themselves and systematic flushing are also essential.*

Finally, to preserve an inoffensive condition in sewers, we must establish within them a systematic ventilation and flushing.

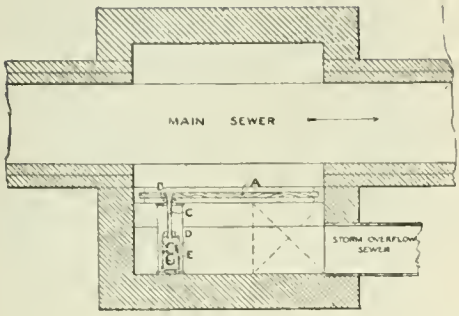
Ventilation is generally secured by the natural differences of temperature existing in various parts of the sewer system. It has been found best to let the air circulation take care of itself, by providing the necessary openings, ample in size, for the air to enter and others for it to escape. It happens sometimes on cold days that the air circulation is in the opposite direction to that on hot days. This reversal of current is not objectionable if the sewers have no foul deposits in them and if the ventilation has at all times been free and ample. Artificial ventilation was thought necessary in former times and numerous contrivances were introduced. Today, after long experience, it is known, when sewers are properly designed and built, and properly cleaned and flushed, that natural ventilation is entirely sufficient and satisfactory.

Flushing is another important requirement for the sewers to prevent offensive odors in them. Above ground, within our houses and on our bodies, we use ample amounts of water for cleansing purposes. Below ground in sewers, ample flushing is equally and even more necessary, due to the relatively greater concentration of unstable decomposing organic matter. Unfortunately in our country the finishing of sewers has not been given as much attention as is desirable. In almost all European countries, both small and large sewers are flushed frequently, varying from several times a week to once in one or two months. The results of this frequent flushing are very satisfactory and the money is willingly appropriated.

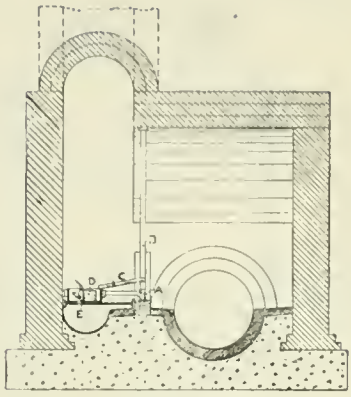
In our country, particularly in smaller cities, we have extensively introduced automatic flush tanks at the heads of all pipe sewers. While these tanks keep the upper ends of the sewers clean and free from deposit in a very satisfactory manner, they do not keep the larger sewers lower down the line free from deposits and odors. In this respect our sewer systems could be greatly improved and the odors therefrom materially diminished.

¶ PUMPING *for a low lift,* AERATION, *and* SCREENING *at various points in the system are suggested as methods of reducing nuisance from sewage at end of long slow flow.*

When collecting sewers are long and the distance to the outfall is great, which fact is generally associated with flat grades and slow velocities, we have almost always some putrefaction and offensive odors arising near the lower end. During the long run the oxygen has become exhausted and hydrogen compounds, notably sulphureted hydrogen, are developed. The obviation of this condition may be secured by emphasizing several remedies above mentioned. For instance, the surface of the sewer should be made especially smooth, means might be employed for a more thoro flushing than would otherwise be necessary and the grades and sewage velocities might be improved by the introduction of a low lift or booster pumping plant.



— PLAN —



— SECTION —

DESIGN *for storm overflow sewer and setting of apparatus for taking sample of sewage or storm water at any height for which it may be set.*

Still another expedient might be practicable, by replenishing thru artificial aeration the dissolved air, from which the oxygen has been exhausted and putrefaction has been initiated. Experiments have been made recently both in England and America to accomplish this purpose and have resulted in more or less success. Where it is possible to force air into a sewage pumping main, under a pressure of at least one atmosphere, good results have been obtained with the sewage after its discharge into a sewer. Distributing air into the sewage within the flowing section and under ordinary pressure seems as yet to have given only moderately good results.

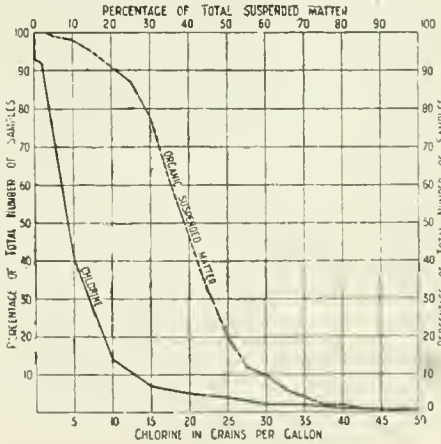
There is one more means by which the fouling of sewage on a long run can be reduced and incidentally also the expense of the final sewage treatment. When we consider that but very little of the organic matter which is discharged into sewers at the house is dissolved, and that about one-half of it is dissolved when the sewage reached the outfall of an average city, and also that dissolved matter withdraws oxygen from the water more quickly than the solid matter, we must conclude that a removal of solid matter by fine screening or short-time deposition higher up the sewer, before much of it is dissolved, would be of benefit. A number of small settling tanks near the beginning of the main sewers might, for instance, not only prevent foul odors near the lower districts, but prevent also the necessity and expense of works for oxidizing the amount of dissolved organic matter which is thus eliminated.

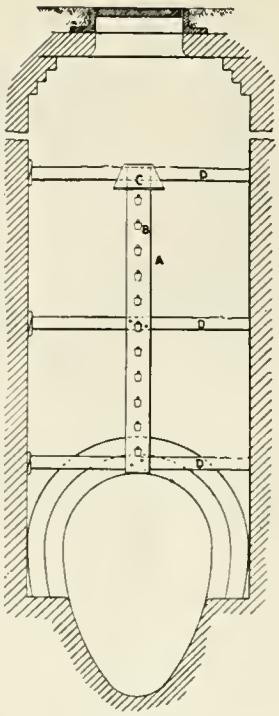
Automatic Sampling and Measurement of Sewage

T. DeCourcey Meade, city surveyor of Manchester, England, has used with much success the apparatus which is described as follows:

Altho the existing sewers are relieved by storm overflows, they work under a head of water in times of storm. Many local and tributary sewers also become surcharged during periods of heavy rain, chiefly owing to the insufficiency of the

DIAGRAM *showing pretrescibility of storm water overflow in sewer. The full line shows the percentage of the total number of samples containing the various amounts of chlorine, given on the lower horizontal scale. The broken line makes like showing for total suspended matter, given on upper horizontal scale.*


PERCENTAGE OF TOTAL SUSPENDED MATTER
0 10 20 30 40 50 60 70 80 90 100
100 90 80 70 60 50 40 30 20 10 0
PERCENTAGE OF TOTAL NUMBER OF SAMPLES
ORGANIC SUSPENDED MATTER
CHLORINE
5 10 15 20 25 30 35 40 45 50
CHLORINE IN GRAINS PER GALLON



SMALL TIN CANS B *on the board A by filling as water rises show height to which sewage rises in manhole, thus giving the maximum rate of flow of sewage between observations.*

main sewers into which they discharge.

In Manchester there are upwards of 200 storm overflows, and no two of these are exactly similar in construction. As the main drainage work proceeded and the old seyers were exposed, an accurate survey was made and detail drawings prepared to meet the conditions found in each case.

It was necessary to ascertain the character of the diluted sewage passing over the sill of each overflow at the beginning of a storm. In a town where there are a number of overflows it is obviously impossible to take the samples by hand. A simple and cheap arrangement for securing these samples was therefore devised and successfully used for several years in Manchester.

The figures 1 and 2 show a plan and section of a typical storm overflow chamber for small sewers, with the automatic sampler in position. The arrangement consists of—

An overflow sill (A), an upright wooden post (B), a leaden gutter or channel (C), leading the storm water to the sampling apparatus, which consists of a receiver (D), fitted with a heavily weighted lid; from the back of the latter a wire projects to which is attached a cork; the whole apparatus is placed in a strong wooden box or cistern (E).

The receiver (D) is closely covered with an airtight joint when the lid falls. The cost of this sampling appliance, fixed complete, is under a sovereign ($5).

The following diagram (Fig. 3) shows the putrescibility of the samples taken at the sill level of the storm overflows in the city, arranged in order of grains of chlorine per gallon, this being considered an index of the putrescibility. The percentage of organic matter in the total suspended matter is also indicated on the diagram. It will be observed that only a comparatively small percentage of the samples taken have high chlorine figures or a high percentage of organic matter.

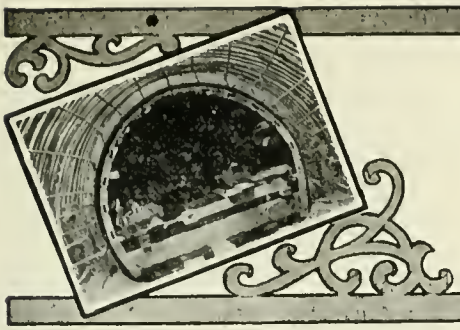
For the purpose of obtaining accurate particulars of flood levels in sewers, the arraugement shown by Fig. 4 has been successfully employed in Manchester.

The device consists of a board (A) placed vertically in the manhole shaft to support a number of small tins (B) placed at regular intervals. These vessels fill as the water rises and record the height to which the sewers have been surcharged. The tins are protected from roof drippings by the hood (C).

Concrete Pile Standards

A booklet just published by Hunley Abbott, 11 Pine street, New York, entitled "Concrete Pile Standards," is a book of drawings, specifications and other data prepared for the assistance and convenience of engineers, architects and designers who have to prepare specifications and plans for concrete pile foundations. It touches on practically every step in the design of such foundations and much time and expense may be saved by the use of these standards. The price of the book is 50 cents and it contains:

1. Standard details of reinforced concrete pile caps, full explanation of their design and large scale dimensioned drawings of all the standard and many special cases with estimated quantities and bills of material.
2. Standard specifications for all types of concrete piles.
3. Concrete vs. wooden piles; a comparison of costs under various soil conditions.
4. The theory of pile support, with actual values for friction and bearing quoted from recognized authorities.
5. Detailed description and drawing showing the method of testing a concrete pile.



CONCRETE

Testing and Handling of Aggregates for Concrete

From a paper by H. S. Mattimore, First Assistant Engineer, New York State Highway Commission, before the Association of American Portland Cement Manufacturers.

At the invitation of your association I have been directed by the chief engineer of the New York State Highway Commission to discuss the methods of testing concrete aggregates with special regard to those used in concrete pavements. We feel as though we have succeeded in securing a concrete of an excellent quality on our highways principally by the selection of good materials and a first-class quality of engineering inspection.

It is absolutely essential that a good quality of cement should be used in concrete, but we should constantly keep in mind that cement, altho the important ingredient in concrete, is only one of several ingredients used in mixing this product, and in order to secure a first-class concrete the other ingredients must also be of a good quality.

To insure a fine aggregate of high grade our department has drawn up the following definite specifications: "Fine aggregate shall consist of sand, free from organic matter; that which shows a coating of the grains shall not be used until satisfactorily washed." No. 1 sand for use in concrete pavement shall be of the following gradation: 100 per cent. shall pass a ¼-inch screen; not more than 20 per cent. shall pass a No. 50 sieve and not more than 6 per cent shall pass a No. 100 sieve." "Sand may be rejected for this class if it contains more than 5 per cent. of loam and silt." "Mortar in the proportion of one part of cement to three parts of the sand to be tested shall develop a compressive strength at least equal to the strength of a similar mortar of the same age composed of the same cement and standard Ottawa sand."

"Screenings when approved in writing by the chief engineer may be substituted for a portion of No. 1, 2 and 3 sand under the following conditions: The screenings shall be free from dust coating and other dirt, 100 per cent. shall pass a ¼-inch screen and not more than 6 per cent. shall pass a No. 100 sieve." The compressive strength of a mortar in which the screenings and sand are in the proportions intended for use, shall be at least equal to the standard strength obtained with sand of the given class."

You will notice from the specifications quoted above that the only allowable use for stone screenings as fine aggregate is when mixed with a proportion of sand. We have had some field tests made on using all screenings for fine aggregate and these have shown such doubtful results that it was not thought advisable to replace all of the sand by screenings. It is possible to get good concrete with screenings in laboratory test, but when tried on a large scale in the field it is extremely difficult to get a uniform well-graded material. The proper proportion of screenings from the hard variety of stone will improve a fine-grained sand, but the high costs for careful inspection and proper mixing is likely to make their use prohibitive, except in instances where a good quality of sand is very expensive.

The specification for stone as coarse aggregate in concrete requires that samples shall be tested before being used in the work. It must be free from dirt and coating of any kind. As a tentative specification we require that stone for use in concrete pavement shall show a "French coefficient" of at least nine when tested in the standard abrasion test for stone.

Some few miles of concrete pavement have been built with gravel used as coarse aggregate. These were in sections where a very high grade was available. Such material was all tested and had to meet the equirements of being composed of all sound, durable stone, and to be absolutely clean and free from coating. We have found the gravel banks in a large part of the state to run so non-uniform that it was not thought advisable to use this product in concrete pavements except in limited areas where we have assured our-

selves from past experiences that a uniform product can be obtained.

An endeavor is made to use local materials as far as possible in all our work, and the above specifications were written after a careful study of several hundred sand tests from widely scattered portions of the State. Availability was considered with the idea of quality paramount.

During the routine of the physical laboratory within the past year the work included the examination and testing of samples representing 1,080,580 barrels of cement, 909 samples of sand and 857 samples of stone. The cements were tested according to the standard methods of the American Society for Testing Materials, with which no doubt you are all familiar. There being no standard tests for sands, the following is a brief outline of the tests and methods employed in our laboratory:

Gradation—1,000 grams of the sand to be tested, after a careful weighing, is screened through the ¼-inch, No. 6, No. 20, No. 50, No. 100 and No. 200 mesh sieves. After weighing the residue on these sieves, the proportions passing are readily computed. We found from past experiences that these are the essential sieves for an intelligent judgment of the gradation.

Voids.—For the determination of the voids, the sand is placed and loosely compacted in a graduated cylinder. This latter has a hole drilled in the bottom in which a tube is connected leading from a burette filled with water. This apparatus is placed and worked so that gravity causes the water to rise slowly thru the sand, forcing the air ahead. By reading from the burette the amount of water which has flowed out, the voids can be computed with a practical degree of accuracy. This method of allowing the water to flow in from the bottom rather than from the top of the sand eliminates the forming of air pockets, which are extremely difficult to avoid by the latter method.

Loam.—For the determination of the amount of loam, a portion of the sand sample is placed in a graduated cylinder and well covered with water. This is thoroly agitated and then allowed to settle from ten to twenty-four hours. The loam and silt, which readily separate from the sand, are deposited on top of the sand and the proportion can easily be computed. This method of loam determination by volume, we believe, is as refined a determination as necessary to fit all practical requirements. It also allows an easy method of checking in the field.

Compression Tests.—The majority of our compression tests are made on 3-inch cubes mixed 1 part of cement to 3 parts of the sand. These are stored in moist air and broken in fourteen days; 4 cubes are made from each sand, 2 from the natural product and 2 from the washed. For a comparison of the compression, 4 cubes of the same size mixed with standard Ottawa sand and the same cement are made, stored and broken under the same condition and at the same age. The cement used for this purpose is a blend mixed in the laboratory from cements which show similar characteristics under tests. The cement and sand in the cubes are proportioned by volume rather than weight to avoid the variation of the latter in sands of different character. The cement, altho measured by volume, is carefully checked by weight to eliminate different degrees of compactness in measuring.

At present time we are running a series of sand compressions on both two and three-inch cubes for the ultimate purpose of using the smaller size cube. These latter will be made up in lots of four, two of which will be broken at seven days and two at twenty-eight days. This in many cases will decrease the time necessary for a sand test and also enable us to observe the relations of the strengths at the different ages.

Of our tests we consider the compression strength of the sand in mortar of major importance, but as this depends more or less on other determinations, especially gradation and percent of loam, silt or organic matter, it is advisable to run a full test in order to properly judge the material.

Occasionally sands are tested for tensile strength, but our experience on the relation between tension and compression strengths of sand mortars has verified the results obtained by other investigators in the fact that this relationship is so nonuniform that it is absolutely unreliable, and as we build plain concrete to withstand compression rather than tension, we should test it from that standpoint.

During the course of construction, the concrete highways are under constant supervision of competent engineers, their duties not only include ordinary highway way engineering work, but they are required to closely inspect all concrete aggregates. This especially refers to sand and gravel supplies, and when such material shows any great change in character, this being determined by field tests for gradation and loam, such conditions are immediately reported to their superior engineer, who takes steps to rectify them and compel the contractor to secure suitable materials.

One of the important checks instituted within the past year on our concrete work was in the testing of the finished product. Engineers in charge of concrete work are required to make 6-inch cubes from the

mixed concrete as deposited in the work. Two cubes are taken from every 500 cubic yards of concrete laid. This, in the case of a concrete highway sixteen feet wide and of our standard thickness represents about 1,700 linear feet of roadway. These specimens are stored in moist sand near the highway for twenty-one days, at which time they are sent to the laboratory, where at twenty-eight days they are tested for compressive strength. The engineers on the highways are notified of the results of such tests and this seems to have promoted a friendly rivalry between them to endeavor to obtain the best possible concrete. This pride in accomplishment certainly tends toward obtaining desired results. The chiefs of the department do all in their power to build an excellent type of highway, but in the end much depends on the engineers directly in charge.

By means of the above described tests I know we obtain a good quality of aggregates and the final tests on the field cubes give us an excellent check on both material and workmanship, but we also realize that the using of concrete for highway surfacing introduces the factor of making a concrete to resist impact and abrasion. This at present is well taken care of by using a rich mixture, but at the same time we are studying both concrete and mortars from this standpoint and hope in the near future to be able to devise some method of testing the abrasive and impact resistance of various aggregates.

The curves in the accompanying diagram are self-explanatory. Their main value is that they are the results of field tests, thus giving a good illustration of the concrete obtained in actual practice. I believe this is a good fair comparison of stone and gravel concrete, as both of these aggregates were of high grade, particular attention being paid to obtain a clean, uniform product passing all requirements for this class of concrete.

You will notice the material made with screenings, altho showing a fair compression strength, is much below that obtained with a good sand. These latter cubes were made from concrete placed on highways previous to the adoption of the specifications quoted above.

Expansion Joint for Concrete Paving

The accompanying photograph shows the method of placing the Trus-Con armor plates for protecting joints in concrete paving. The form of the plate, with the double hooks for tying the plate back into the concrete, can be seen clearly. The picture was taken on McKinley Place, Grosse Pointe, Mich., opposite the Country Club, running thru a district of expensive suburban homes.

Development in Culvert Construction

By Edward J. Whalen, Syracuse, N. Y.

One of the essential features of a modern road is the proper drainage. Usually ditches run along the sides or on one side of a road, and at certain points in order to keep the water level down, the water is carried from one side of the road to the other. These ditches should be of good size, and be able to take care of all ordinary rainstorms. They should be free from obstructions so as not to block up the ditch, causing the water to rise too high. If the water stands in the ditch it soaks into the base of the road. The result is a big mudhole in the road, the top settles down, and the people who use the road are not very much in favor of riding over it in an automobile. Sometimes, you will find water going over the road, caused by a culvert being too small.

What is a culvert? It is a covered channel, to carry water from one side of the road to the other.

Years ago, culverts were made from wood, as that was the handiest material at that time. However, it is not used much any more. It was very expensive, and dangerous, as it decayed quickly, and many lawsuits were brought against townships on account of horses, cattle, etc., being injured, or legs broken by stepping into holes. Traction engines usually dropped through every one they came to. It is very seldom that a wooden culvert is found nowadays. They are and should be a thing of the past.

As time went on, manufacturers brought forward the drain tile to be used in place of a culvert. They were taken hold of readily, and came into general use in many localities, and were of great benefit to their manufacturers. In fact, I know of a culvert made of drain tile which was replaced one a year for several years. However, the drain tile has the disadvantage of causing high water levels, and insufficient capacity, owing to their being round. The frosts and other causes lead to their disintegration, and as a result of heavy traffic they soon break down.

Later on, commercially minded people began bringing out pipe, sheet iron tubes, etc., for culvert use.

States which have modern, efficient, highway organizations, have prohibited their use, and the use of inefficient, poor quality pipes is not encouraged anywhere. They lack sufficient capacity on account of their being round, and cause high water levels. Sometime these pipes are galvanized and are used in primitive road building today. That is, where they are experimenting, not profiting by the mistakes of others. They are hardly ever provided with head walls, which are very essential. A culvert without a head wall is like a tack without a head. You can put it in, but it is not much good. Such a substitute for a culvert seldom if ever, was as long as the width of the road. The water wore away the sides of the road, and if you drove along the road it was necessary to keep in the middle of the road or get wrecked. In a few months time the small pipes became clogged and filled up, and perhaps their location was lost.

Now, as we understand it, the primary object in putting in a culvert is to carry the water from one side of the road to the other, a culvert being an artificial archway under the road. The first idea should be to have a permanent and a durable culvert, with ample capacity, and the culvert should be wide enough to take care of flood conditions, and at normal times to furnish a good pasasge for the water. Especially in the spring, as the surface of the earth road at this time is soft, is easiyl washed away, and should not be forced to flow across the road. We might say, that the road surface should be rounded also.

It would be a better and more economical procedure to build where the head room is limited a concrete culvert which could be a semi-circular nature, with a radius of 12 inches. for example. This would have the same head room as a 12-inch pipe but would have twice the capacity. It is very strange that anyone who uses his head would use a small round pipe in this instance if he wanted to lower the water level and increase the capacity. He simply works against his better judgment. Here again, a great mistake is made, they sometimes use a larger pipe, and raise the surface of the road, resulting in a hump in the road which is rather unpleasant to drive over, unsightly aud unnecessary. In some places they call them "thank-youmams," but no one is thankful that they are there.

All this experimental work is absolutely unnecessary. Semi-arch, standard, permanent, beautiful, monolithic concrete culverts are easily, quickly, and readily constructed by using a collapsible steel culvert form, with equipment for building head walls, wing walls, etc., and requires no more head room than the little round pipe. Such a concrete culvert is based on the universal law of efficiency and economy, and has a 300 per cent. lower water level.

New York state has certain standards for her culvert construction, and all these standards have to be adhered to, altho they have flat tops. Still every one knows that an arch gives greater strength, and uses less material, and

gives greater capacity. However, New York state standard structures were designed by the world's greatest engineers. Some of New York state standards are as follows: 24x15 inches, 27x24 inches, 30x24 inches, 54x24 inches, etc. The tendency sl to have the culvert long spau and low rise. Any of these standards are easily built by a modern, standard, collapsible steel form.

Standardization has been adopted in some states, and should be in all. However, they are only in evidence in states which have diligent highway departments. This custom of letting every highway official do as he wants to results in peculiar developments, which show the lack of engineering judgment.

Concrete in culvert construction is superseding all other materials, the same as it did in sidewalk, curb, gutter, bridge, and road work. It is permanent, and saves huge sums of money every year.

The concrete mixer has been a great help in the work. There are a good many mixers on the market, in all sizes and conditions, and their prices are reasonable. They are labor savers and hence, moneymakers.

However, the mixing of concrete does not end it all. One should have the right kind of a mold or form to pour the concrete into. One that is easily and quickly set up, and can be readily removed. One that is durable, rustproof, and watertight, and can be used for a number of different styles. The remedy is a good, collapsible, steel, culvert form.

Lumber is too expensive. It requires the services of an expert carpenter to build a wooden form, moreover a wooden form cannot be used more than three times, before it is all warped out of shape, and has to be thrown away, as the concrete is wet, and the air is dry, and the result is the form is soon wracked to pieces. Another great trouble is that the cement in solution passes out through the cracks of the wooden form, and the culvert is filled with cracks, resulting in an impoverished culvert, with a short life. Disintegration takes place. Some people blame the concrete or cement, however, it is the fault of the one who permitted the use of the wooden form.

Build your culverts from Boston to San Francisco of concrete over a standardized steel culvert form, and instead of ill-looking culverts, you will have beautiful, standard, monolithic, permanent concrete culverts, which will be monuments to their erectors for all time.

The sizes of culverts should be the same for the same conditions everywhere, and should be as standard as the wagon gage, railroad gage, etc.

Universal Safety Standards

The first volume of the Universal Safety Standards, "Machine Shop and Foundry," by Carl M. Hansen, M. E, chief engineer of the Workmen's Compensation Service Bureau, New York City, M. Am. Soc. M. E., is a handbook of concrete examples of safeguarding and rules for practice in machine shops and foundries.

This is the first one of a series of books which will be issued under the direction of the Workmen's Compensation Service Bureau, in the course of the next two or three years. The titles of the others will be Woodworking, Leather and Shoe, Mercantile and Theaters, Textile and Clothing, Brick Pottery and Glass, Paper, Printing and Allied trades, Electrical, Grain and Flour Milling, Dyeing and Laundry, Mining, Miscellaneous. These books will all be compiled under the direction and with the approval of the Workmen's Compensation Service Bureau. They will all bear the endorsement of the leading compensation and liability insurance companies and these standards will be exclusively used in fixing the rates for workmen's compensation insurance under the Universal Analytic Schedule.

Compensation on laws have made indemnity for accidents compulsory. This indemnity is one of the large items in the cost of production. To reduce the cost of production and effect a saving in operation, accident prevention is one of the most prolific fields. Employers and others interested in safety need authoritative information on the methods of assuring safety which will meet the requirements of the rulings of their insurance companies.

In order to supply this demand, safety must be standardized. The Workmen's Compensation Bureau has seen fit to adopt Universal Safety Standards as its minimum requirements for industrial safety. It makes this approval because the book "Machine Shop and Foundry" (Universal Safety Standards) represents, in its opinion, the ideal condition for which they are constantly striving. These standards were prepared with the aid of some eighty engineers working under Mr. Carl M. Hansen's direction and with the advice of and contributions from the leading industrial organizations in the country.

The book is purely a "How" book on safety as opposed to the usual type of "Why" book. It starts where others stop; viz., where others convince you that safety is necessary, this book shows what is necessary for safety. It describes and specifies conditions and machines and safe means and measures for guarding these conditions and machines.

But it does not stop there. With each

specification it shows a detailed drawing of what the specification means, all of which is the application of the principle of safeguarding. This arrangement makes everything absolutely clear even to the machine operator. Very interesting examples are the treatment of stairways, steam engine guarding and grinding wheel protection.

This system is now being applied in thirteen states and last year twenty thousand plants were merit-rated, having one million two hundred thousand employes and with a payroll of seven hundred million dollars. This produced a saving in premiums in the neighborhood of two million dollars. The cost of installing safety devices in general is made up in the savings on insurance premiums. As part of this system, it has become necessary to standardize safety as a basis for rate deduction, and this volume, "Machine Shop and Foundry" is the result. It is the first time that a comprehensive study of this kind has ever been made.

The volume is attractively bound in limp seal leather, 312 pages, indexed, price, $3.00 net, and is issued by the Universal Safety Standards Publishing Company, 12th and Race Sts., Philadelphia, Pa.

By-Product Coke Oven Gas for Chattanooga

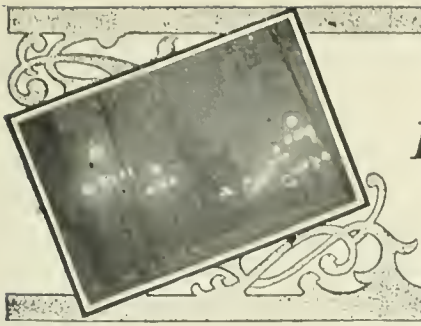
The Chattanooga Gas Co., Chattanooga, Tenn., is making elaborate prepartions to push the sale of gas for manufacturing purposes, incident to their contract with the Chattanooga Gas & Coal Products Co. to bny 200,000 feet of gas daily. The latter concern is now erecting a 12-oven plant, each oven of 16 tons capacity, of the Roberts type. The plant, it is anticipated, will be finished and in operation next spring. When completed, the investment will be between $450,000 and $500,000. The plant is a by-product one, the company itself planning to develop, aside from gas for furnace, foundry and domestic use, coke, tar and sulphate of ammonia. Further than that the coal products company will not go, but is anticipated that other industries will be attracted by the supply of by-products, such as tar, and establish plants for the distillation and conversion of same into commercial forms. Also, there is good reason to believe that the gas, sold at rates fairly competitive with natural gas, will attract manufacturing lines such as pottery and glass, the former not now represented in the Chattanooga district at all, the latter by only one factory.

The by-product plant is located in one of the suburbs of Chattanooga. The company is subsidiary to the Durham Coal and Coke Co., of that city, and will coke coal from the immense coal lands of that company. It will be necessary to lay some four miles of gas mains to pipe the gas from the by-product ovens to the distributing system of the Chattanooga Gas Co. The first order for pipe aggregated 22,000 feet, or an expenditure, it is stated, of about $20,000. The order was placed with the James Supply Co., of Chattanooga.

The distributing company plans an extensive campaign for inducing manufacturers to adopt the use of gas for mechanical purposes instead of coal. To interview manufacturers of various gas machine appliances, General Manager S. E. DeFrese, who is president of the Southern Gas Association, visited Chicago recently in connection with his trip to the National Commercial Gas Association meeting in Minneapolis. On his return, he began the remodelling of the downtown office and exhibit rooms in order to install an exhibit of gas appliances for the special purpose of demonstrating the various uses to which gas can be put in the mechanical arts.

Introduction of by-product ovens at Chattanooga creates a very interesting situation and one which will doubtless be watched keenly by those connected with the gas industry and lines of manufacturing in which gas is used. It should help very patently in the industrial growth of Chattanooga, which is already an important manufacturing center with nearly 300 factories and greater diversity of products (1,137 articles) than any other southern city. The Chattanooga district is one of the principal soft coal producing sections of the country, 20,000 tons being mined daily. The Roberts oven, furnished for the plant at Chattanooga by the American Coal and By-Product Coke Co., Chicago, is the only flueless type on the market. It is claimed to coke coal in a shorter time than other types and also to produce coke suitable for metallurgical purposes from coals which have heretofore been technically known as non-coking.

The Western Gas Construction Co., Fort Wayne, Ind., is furnishing the by-product equipment, which is standard, and of the so-called indirect process for ammonia recovery. Kerr-Murray Co., Chicago, were awarded contract for gas holder; Wallman, Seaver, Morgan & Co., for coke pushing and coal levelling machinery, and lorry cars; R. H. Beaumont & Co., Philadelphia, for coal and coke conveying, screening and grinding machinery; American Refractories Co., Chicago, silica brick. Several Chattanooga firms also participants, such as the Casey Hedges Co. and Converse Bridge Co.



FIRE AND WATER

Locating and Mapping Pipes and Valves in an Old Water Works System

By Carleton E. Davis, Chief of Bureau of Water, Philadelphia, Pa., before Section D, American Association for the Advancement of Science.

FOR the adequate control and effective operation of the distribution system of a municipal water works, the location of pipes and valves should be definitely known, as well as the function performed by such pipes and valves. Data should be recorded in such a way as to be readily understood and interpreted and should be accessible for immediate use, in case of an emergency, by more than one person. The more complex the system, the more important becomes definite and easily used recorded information stored only in the minds of certain individuals.

For one reason or another, too much dependence has been placed upon the personal knowledge of individuals, or, perhaps, a single employe, and too little has been done upon the work of recording facts and data in such shape as to be of use by any person, incidentally extending thereby the usefulness of many persons.

The lack of proper records and plans may be felt in a minor degree as an everyday handicap, but is liable to be particularly emphasized in case of an accident, such as a break in a main pipe. Here the flow of water must be stopped, and the circulation readjusted so as to cause as little annoyance and inconvenience to consumers as possible. This means that a number of valves must be first found, and then operated in such a manner as to produce the desired results, and such work must be done quickly.

Of scarcely secondary importance is the necessity of similar records for service pipe connections from the mains in the streets to the properties of the consumers. Affiliated with these latter records are the data recording the arrangement of water piping inside buildings or private properties, with special reference to unauthorized outlets or connections with a private, and possibly contaminated, water supply for fire or manufacturing purposes.

The situation in Philadelphia may be typical. It is not intended in this paper to give the details of the locating and mapping work that is being done in this city, but to outline briefly the general principles controlling such work.

The original water works of Philadelphia were constructed about 1801. The first cast-iron pipe was laid in 1817, and considerable pipe which was in the ground as early as 1820 or 1830 is still doing service in the distribution system. The present city is an amalgamation of a number of distinct municipalities, some of which had water supplies at the time of incorporation with the larger community. Such water works were joined to the Philadelphia supply and are even now a part of the general system.

As the city of Philadelphia has grown, various water supply projects have been developed, used, outgrown and abandoned in whole or in part. During the last fifteen years the introduction of a filtered water supply has brought about a radical readjustment of the principal supply mains and a realignment of the distribution districts.

Certain general maps and plans are available, invaluable as a basis of a more comprehensive and useful record scheme, and representing a large amount of research in the past, hard work and wise foresight. These particular maps in Philadelphia were compiled by Mr. William Whitby, of the Bureau of Water. They are now being developed and expanded with a view of increasing the amount of detailed information, distributing such information widely thruout the Water Bureau, and putting it in such shape that a larger number of employes can be used to a greater advantage by reason of its existence and accessibility.

The scheme provides certain general features:

1. Data used chiefly for controlling and regulating the amount and pressure of water thruout the system, or in other words, data used in operating the supply.

Under this head are maps defining the limits of the several distinct distribution areas, which maps are accompanied by data showing the sources of supply for each area and a list of valves controlling the supply; likewise general maps showing all large mains, reservoirs and pumping stations, together with detail maps of the piping system and operating valves at the pumping stations, filters and reservoirs.

2. Data used chiefly for repairs and maintenance.

Under this head are maps showing the complete gridiron of distribution pipes on which the locations of all valves and hydrants are indicated. The detail of such maps is expanded by intersection plans showing on a larger scale the situation at each street intersection. Each street intersection is mapped on a separate plan of a size convenient for use in the field.

3. Data used chiefly for the business relations between the consumer and the Bureau of Water.

Under this heading come data relating to service pipe connections, such as the location, depth, size, date of insertion, kind of pipe, etc. These data are listed in a card index and filed by streets and numbers.

The system likewise proposes under this head full plans of all pipes in important establishments which may have a special supply for sprinkler systems or other fire protection. These plans will indicate the relations between pipes carrying city water and private pipes which may carry a possible polluted water from a private source. introduced for the purpose of fire protection or manufacturing. The necessity for the complete severance of these dual supplies can be readily seen.

¶ THE PROGRAM *for locating and mapping existing pipes is laid out, with suggestions of methods for use in special cases.*

Assuming an available force of sufficient size and individual experience and capacity, the work of mapping pipes and valves proceeds normally along three lines:

1. Compilation of existing data wherever and however those data may be listed:

Reports and plans were searched and examined, though of course the chief mine of information was found to be in the memory of old employes. Considerable tact and discriminating judgment were necessary to elicit the information stored in the minds of these old employes and give to such information its true value and assign to it its proper place.

2. An investigation and determination of the present and possible function and use of the several parts of the system.

In investigating the use and possibilities of the present pipes, pitometer corps, equipped with apparatus to measure readily the flow in any pipe, have been used to great advantage.

These pitometer corps serve a twofold ourpose, for, while measuring and studying the flow of water and determining its fluctuation, they at the same time detect leaks and locate points of undue use or waste. Incidental to this study of the flow is the operation of control valves, in the course of which the location of the valves is verified, their condition and character are noted, and other data obtained which form part of the detail location maps.

More or less information is likewise brought to light concerning service pipes, even some unknown ones being unearthed. Various devices are on the market which aid in locating lost service pipes, tho sometimes nothing but digging will bring the desired information.

Governing the rather restricted operations of the pitometer corps is an overhead study of the whole distribution field, including investigation of proposed changes in the major control system.

Like the pitometer corps, which obtains certain incidental facts while working along definite lines for the purpose of obtaining other information, the general repair and maintenance forces are likewise utilized for the same purpose. Without adding noticeably to their labor, they turn in much that is valuable in the shape of permanent records. Each foreman in charge of a repair or maintenance crew is furnished with a pad of paper showing the lines of typical street intersection with house lines, curb lines, etc., printed on it. Whenever and wherever such a crew is called for work, the foreman is required in his spare minutes, which always occur in such an operation, to list up on these blanks such data as an intelligent inspection of his immediate vicinity will discover. He likewise is required to operate such valves as can be conveniently handled and turn in a record of such operation. These field records are sent in to a central office and are used in verifying permanent records or for making new records on the detailed per diem maps.

3. The proper recording of new work and the reduction to tangible shape of existing data.

The system in vogue in Philadelphia depends upon the centralized overhead control. All new work is directed from a central office, thereby insuring uniform practice and procedure, stimulating branch offices by the feeling that their returns are scrutinized and compared with similar returns from other branch offices. As the attempt is made to secure results from what would otherwise be lost time, or, in other words, a utilized by-product, this introduction of competition is valuable. Uniform practice and procedure are essential, as a man transferred from one section of the city to another feels at home among the familiar records, even tho the geography of the district is strange.

Book records have been discarded as far as possible in favor of records capable of easy and rapid reproduction. A complete and satisfactory record, distributed as widely as desired, may not be obtained for some time to come, but enough has already been accomplished to prove the worth of the system.

Combination Street Sweeper and Sprinkler

The accompanying photograph shows a combination street sweeper and sprinkler which has several points of advantage. The machine does the work of both sprinkler and sweeper in a very satisfactory manner.

The sweeper is the regular Acme sweeper of the Studebaker Corporation of South Bend, Ind., nearly all of which is clearly seen in the photograph. The steel frame and the wheels show for themselves. The equalizing lever for raising and lowering the broom is seen by the side of the driver's seat. The iron shield in front of the broom, the apron seen outside the large rear wheel at the left of the picture and proper sprinkling ahead of the machine keep the dust down to a minimum.

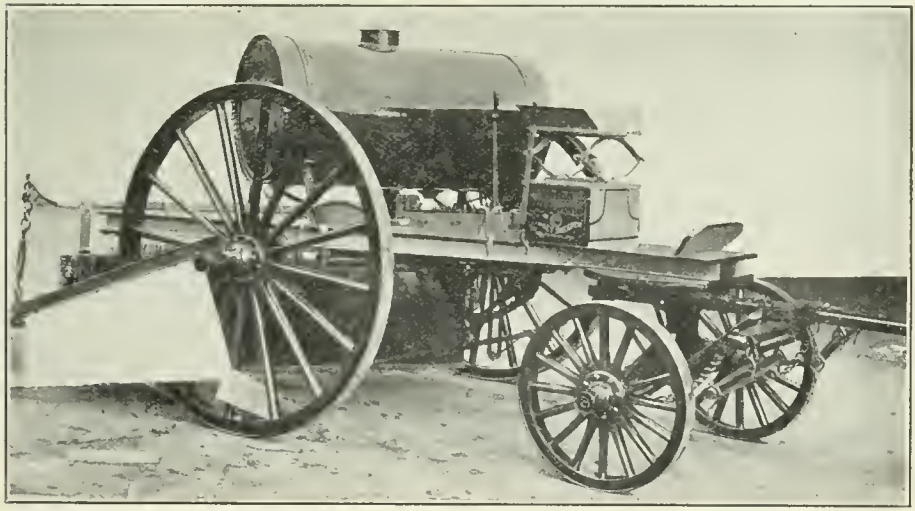
The sprinkling attachment consists of a 175-gallon galvanized steel tank, mounted on top of the frame behind the driver's seat, as shown. Water from this tank is discharged thru its bottom by means of a perforated pipe seen in the picture, running parallel with and just in front of the broom. The lever nearest the driver's seat opens and closes the valves controlling the discharge of the water, which are so constructed that more or less may be delivered, according to the needs for dust-laying purposes.

A few of the cities using this combination machine are Salem, W. Va., West Newton, Pa., Moultrie, Ga., Winston-Salem, N. C., Jacksonville, Fla., El Paso, Tex., Portage, Wis., Krugman, Peru, and Van Buren, Ind.

Automobile Fire Apparatus for Grand Rapids, Mich.

At a recent meeting of the Board of Police and Fire Commissioners of Grand Rapids, Mich., it was decided to place an engine in Station 12 and to put an additional automobile fuel wagon in service.

All the ladder companies in the city now have automobile apparatus. The chief officers have been provided recently with automobiles, also two of the larger engines with tractors, and five more automobile hose wagons and two chemicals have been provided.



Cost of Maintaining Automobile Fire Apparatus

From the report of the department of fire and police of Chattanooga, Tenn., for the year ending September 30, 1014, the following figures are taken as to work done by automobile fire apparatus and cost of maintaining them:

	Chemical.	Engine.	Chief's Car
Alarms answered	320	147	.....
Miles traveled—			
At work	1,122.6	409.9	.....
Exercising ...	266.4	524.7	.....
Chemicals used, gallons	5,097	.....	.....
Feet hose laid at fires	16,500	13,350	.....
Feet ladder used	1,107	.....	.....
Time pumped—			
At fires	....	12 hr 35 m.	....
Practice	....	3 hr. 15 m.	....
Supplies and repairs cost	$311.22	$218.22	$381.47
New equipment cost	.....	25.01	.....

Improvements in Fire Protection for Philadelphia

Of the funds available from Philadelphia's $11,300,000 loan bill of November 19, 1914, only $100,000 was apportioned to the fire department for the purchase of new apparatus. With this it is planned to motorize five outlying engine companies, one other engine now having a motor hose wagon, and two centrally located trucks, and to purchase five new automobile ladder trucks and two automobile combination hose wagons. It is possible also that provisions may be made for the purchase of four more automobile combination wagons and one automobile pumping engine, for establishing one new engine company and three additional hose companies.

Approximately 50 per cent. of the engines at present in service are old and of an obsolete type, and it is difficult to keep them in condition to deliver even as much as half their rated capacity. Extensive repairs on these engines are not justified, and provision should be made each year for the replacement of a certain number of the poorest ones.

The fire-boat, altho recently repaired, is old and of very unsatisfactory type.

As to the water supply, provision has been made for a 48 and 36-inch belt line supply main for South Philadelphia, a 48 and 36-inch supply main across the central portion of West Philadelphia, preliminary filtration and sedimentation basins at the Torresdale plant and the expenditure of about $100,000 for reinforcement of the general system of distribution.

The average annual per capita expense of maintaining the Philadelphia Fire Department has for years approximated 53 per cent. of that borne by the eleven other largest cities of the United States.

Improvements are recommended by the Fire Underwriters as follows:

1. Establish ladder companies with Engine Company 20 in a new station near the present location; at Broad street and Montgomery avenue; with engine companies 40, 41, and 55 or 42.

Additional companies are at present needed at or near Washington avenue and 3d street and Spring Garden street and Ridge avenue, but with the two nearest ladder trucks to each of these locations motorized, these two new companies would no longer be required.

2. Purchase a new water tower and place in service with Ladder Company 2.

3. Establish an engine company in the vicinity of Chester avenue and 54th street.

Unless the three nearest engine companies are motorized in the near future, additional engine companies are also needed in the vicinity of Kensington and Tioga streets and of Media and 54th streets.

4. Establish regular and systematic tests of all engines and of the hose that has been in service over 3 years. Recent tests resulted in purchasing about $15,000 worth of hose with more to follow.

5. Replace during each of the next three years at least ten of the old fire engines.

6. Provide a more rapid extension of the underground system where ducts are available, particularly in all closely built sections, using No. 14 rubber insulated copper wire with extra heavy lead sheathing.

7. Increase the number of box circuits so that not more than twenty boxes shall be connected to any one circuit.

8. Provide for a reduction of the excessively high rates of consumption by the more rapid installation of meters.

9. Provide for the installation of the 60-inch supply main from Lardner's Point station to the distribution system.

10. Provide all possible means for carrying out the general plan of the department, whereby the pressures in the congested value districts will ultimately be raised to approximately 90 pounds.

Municipal Problems

Charter Changes for Los Angeles

On the last day of 1914 the citizens of Los Angeles, Cal., vote on the following proposed changes in their city charter, the cities of California having a large measure of home rule:

1. City manager; abolition of boards and commissions; appointment of department directors; eight councilmen, with mayor president of council.
2. Establishment of boro system for annexed territory to create market for surplus aqueduct water.
3. Authority of the city to issue investment, district and revolving fund bonds to handle the district bonds voted by the newly-formed irrigation district in San Fernando valley and others.
4. Elevation of tracks to parallel streets as well as to cross.
5. Appointment of members of school board by mayor and council.
6. Street railway subway under Silver Lake park and others.
7. Consolidation of city and county tax offices, letting county do the work now done by both city and county tax assessment and collection service.
8. Minority representation, allowing groups of voters to have proportional representation on council.
9. Donations for public parks to be handled by special commissions, thus doing away with such controversies as that between Griffith J. Griffith and the park commission.
10. Authorizing harbor commisslon to make emergency purchaser.

Municipal Police Departments — Their Relative Size.

Compiled by Andrew Linn Bostwick, Municipal Reference Librarian, St. Louis Public Library.

These tables attempt to compare the police forces of the largest cities as to size only. They do not purport to draw any conclusions as to the efficiency of the departments, or any other similar question. It should be borne in mind that tables of this sort are useful only in giving a general idea of the subject. To make a more exact comparison of the sizes of police forces it would be necessary to conduct a most exhaustive study and consider a great many factors that have not been reckoned with here.

The information in the tables is practically all up-to-date. The statistics as to street mileage and number of patrolmen are taken from letters received from official sources in December, 1914. The population figures are those given by the Census Bureau as estimates for 1914; the figures as to area of cities are taken from the World Almanac, which, in turn, received the information direct from the municipalities.

Columns I to IV of the tables are self-explanatory.

Column V shows the total number of patrolmen on the police forces, whether assigned to beats or not.

Column VI shows the average number of patrolmen working at a given time, on beat duty or otherwise. Each city has its own way of dividing its force into two or three platoons, and the systems vary so greatly that in making a general comparison the simplest procedure is to divide the total number of patrolmen by the number of platoons, and compare the results thus obtained.

Columns VII and VIII are self-explanatory.

Column IX furnishes a good basis of comparison—the number of patrolmen on duty per unit of population. (See note to Column VI, above, for explanation of term "on duty.")

Column X is self-explanatory.

Column XI shows another good basis for comparison—the number of patrolmen on duty per unit of city's area.

Column XIII expresses in another form the comparison shown in Column IX.

Column XIII furnishes another basis of comparison—the number of miles of street per patrolman.

Column XIV shows the number of miles of improved streets per patrolman. This again furnishes a good means of compar-

ison. The sections of a city that are built up to any degree, and sufficiently populated to need any amount of police service, are generally those sections that are served by improved highways. Unimproved streets in many cases are mere "paper" streets, in areas not populated at all. For these reasons Column XIV should be considered.

City.	Area in sq. mi.	Population U. S. estim. 1914.	Miles of streets.	Miles of improved streets.	No. of patrolmen.	No. of same on duty (average).	No. of platoons.
	I.	II.	III.	IV.	V.	VI.	VII.
New York	326.8	5,333,537	3,390.00	2,055.00	9,258	3,086	3
Chicago	191.3	2,393,325	2,991.41	1,759.87	3,407	1,136	3
Philadelphia	129.5	1,657,810	1,587.21	1,374.01	3,190	1,063	3
St. Louis	61.3	734,667	932.62	642.39	1,400	467	3
Boston	47.3	733,802	568.03	528.05	1,400	467	3
Cleveland	51.8	639,431	852.00	530.00	680	340	2
Baltimore	31.5	579,590	555.00	515.00	790	263	3
Pittsburgh	41.0	564,878	1,060.00	540.00	699	233	3
Detroit	41.8	537,650	700.00	462.50	908	303	3
San Francisco	46.0	448,502	824.00	414.00	766	255	3
Milwaukee	25.6	417,054	600.00	392.00	500	167	3
Cincinnati	70.0	402,175	971.50	611.50	520	173	3
New Orleans	196.0	361,221	525.00	294.85	245	123	2

City.	No. of patrolmen per 10,000 population.	No. patrolmen on duty per 10,000 population.	No. patrolmen per sq. mile of city's area.	No. patrolmen on duty per sq. mile of city's area.	Population per patrolman on duty.	Miles of streets per patrolman on duty.	Miles of improved streets per patrolman on duty.
	VIII.	IX.	X.	XI.	XII.	XIII.	XIV.
New York	17	5.7	28	9.3	1,728	1.1	0.67
Chicago	14	4.7	17	5.7	2,107	2.6	1.5
Philadelphia	19	6.3	25	8.3	1,560	1.5	1.3
St. Louis	19	6.3	23	7.7	1,573	2.0	1.4
Boston	19	6.3	30	10.0	1,571	1.2	1.1
Cleveland	11	5.6	13	6.5	1,881	2.5	1.6
Baltimore	14	4.7	25	8.3	2,204	2.1	1.9
Pittsburgh	12	4.0	17	5.7	2,424	4.5	2.3
Detroit	17	5.7	21	7.0	1,774	2.3	1.5
San Francisco	17	5.7	17	5.7	1,692	3.1	1.6
Milwaukee	12	4.0	20	6.7	2,497	3.6	2.3
Cincinnati	13	4.3	7	2.3	2,325	5.7	3.5
New Orleans	7	3.5	1	0.5	2,937	4.3	2.4
Average, 13 cities	15	5.1	19	6.4	2,021	2.8	1.8

Municipal Government in Germany

One of the most valuable practical treatises on municipal government which has appeared is William Harbutt Dawson's "Municipal Life and Government in Germany." The author is an Englishman and his book is a comparison of German and English methods of municipal government and of supervision of municipal activities by the central state authorities.

The methods on the whole are so different in the two countries and the results are so correspondingly different that by the time the full comparisons are made we have considered municipal government from almost every possible viewpoint and have some knowledge of the practical results of almost every method which has been applied.

German cities have a long tradition of self-government which is still almost

wholly in practice, notwithstanding the development in later years of the theory and practice of an exceedingly strong central state government. Strange as it may seem, therefore, in an empire in which the central idea is the supremacy of the state, the individual existing for the purposes of the state, rather than the state existing for the benefit of the individuals composing it, we have in practical operation the nearest approach to home-rule in the management of city local affairs which is in existence anywhere.

The various parts of the German Empire have developed according to different systems, and the laws governing cities conform to a large extent with the courses of these developments, so that methods and details are by no means uniform in the cities and towns of the empire. This is particularly true of the details of distribution of administration powers, application of the elective franchise and control of finances.

Ownership and control of land by municipalities, planning of towns and housing policies are under much more direct control of the municipal government than in this country.

Public health and police matters are administered by the local authorities, but are much more directly under the supervision of the central government of the state than are the other municipal activities.

The author shows in detail the various methods in vogue for operating or controlling municipal public service utilities and the extension of such control and ownership beyond the lines usually followed in this contry. Relief of the poor, social welfare work, education, theaters and their municipal operation are also explained.

Municipal financing methods, including taxation of local incomes, real estate, trade, consumption and other taxes which we treat under license systems are fully set forth.

The book closes with a general survey and comparison with English municipal conditions and a series of appendices going into special detail in some important lines.

The author is strongly impressed with the efficiency of German municipal administration. It is interesting to note that this efficiency is attained under a system which is mainly the old bi-cameral city council and mayor, with some differences in methods of election, which we in this country have been trying to discard as out of date and a prevention of proper progress.

It is still more interesting to note that the German efficiency is in large part due to the operation of three principles which we have largely neglected or refused to apply.

The first of these is the divorce of municipal affairs from party politics. This goes so far that a city cannot memorialize parliament with respect to its relations with the central government, because it is not constitutional for a city to pay any attention to political affairs outside its own interests. Councilmen are selected without party or any formal nominations, and, with a very few exceptions, have not been voted for because they belong to any political party.

Second, the administration officials, from the mayor down, are selected on a merit system, seldom so iron-clad as our civil service systems under political nominations are likely to be, and are chosen without reference to their place of residence. As a consequence, there is a profession of municipal administration, just as there is a profession of teaching in this country, and men are promoted from one desk to another, from one department to another, from one city to another, as they demonstrate their fitness to fill the vacancies which occur.

Employment being during good behavior and the lines of promotion being so many and various, really capable city officials are kept up to the height of their efficiency at all times, and those who demonstrate their inefficiency can be dropped without arousing the opposition of a party machine which may shake the whole structure even up to the President.

Third, while the central government apparently has the right, or the strength to assume the right, to interfere in municipal affairs, and has the veto on any elections or appointments, it does not actually interfere in the conduct of municipal affairs by the local officials, and, in any event, it is not possible, as with us, for a group of persons or even a single person with influence in the State Legislature to bring about a change in the form of city government or the term of office or compensation of city officials in cities of a certain class in order to attain his own ends in his own city or to get even with city officials who have not fulfilled his desires.

While some of the changes in form of government in this country have been effective, at least for a while, none of them are effective everywhere and all the time. All three of the principles so prominent in German administration have been advocated in this country, but when tried it has only been half-heartedly or one at a time, and the others have remained to neutralize the good effects of the one. German experience is so definitely satisfactory that it is practically certain that the American city which will first apply the above principles will score the first lasting success.

MISCELLANEOUS

The X Book

One of the most convenient books for the desk of the busy man for his daily use is one called the "X" Book, because it supplies the unknown factor in the problem of keeping track of many things which are before so many busy executives.

It divides the business day into 15-minute periods from 7 until 6, and has space in each division for engagements, record of what was done and when, has a space for a list of the ten most important engagements of the day and a calendar column with space for general memoranda. Each day in the year has a double page of space and the leaves are bound so that the book will lie open anywhere. A bookmark serves to fix the location of the day passing, or any other important page.

As an advance record of coming engagements, a tickler to call attention to the matters of the day and a record of what has been done, there seems to be nothing more to be desired.

G. A. Annable, 47 Broad street, New York, is the publisher and will send the book for $2 in cloth or $2.80 in flexible leather, or it will be sent from this office on receipt of the price.

Iowa Convict Labor on Roads Becomes Self-Respecting

The convicts working on the roads in Iowa have a status differing from that of the convicts in the prisons of practically all other states. In Iowa the men working on the roads receive $2.50 per day for their labor, they themselves paying for their keep and clothing and being at liberty to send the balance to their dependent families. They are still under restriction, but their right to wage lifts them out of the slavery status into that of state wards.

The action of many states in placing those prisoners who can be trusted out to work on the roads is a forward movement. On the roads the prisoner can do work which has value great enough to permit the payment of the wage. Iowa has proved the plan practical; West Virginia, New Jersey, and other states are successfully passing thru the experimental stage, while many more states will enact legislation permitting such work during the coming sessions of the legislatures.

Chats, Chert and Slag as Road Materials

In Missouri a considerable amount of road material is obtained from the tailings of the concentrating mills at the zinc mines. This material, which is put on the market as "chats," consists of small angular fragments of chert and limestone. The zinc companies are very glad to get rid of this waste material, which is loaded on the cars by the railroads of the district at a cost of about 6 or 8 cents a ton. It makes more than ordinarily good roads and is widely distributed all thru the Middle West. It sells in most places at prices ranging from 50 cents to $1 a ton, but in the neighborhood of the mines it can be had for about 15 cents a ton. It is used for railroad ballast as well as road making. The annual output, according to the United States Geological Survey, amounts to about 1,300,000 tons.

In Tennessee and Alabama a quantity of chert is used for road metal, and in many States crushed slag from blast furnaces also furnishes a valuable road material. In Alabama, one of the large iron-producing States, over 2,000,000 short tons of furnace slag, the average value of which was about 25 cents a ton, was crushed and put on the roads last year. Crushed slag is also used as railroad ballast and for concrete and roofing material.

Technical Associations.

The third annual meeting of the Chamber of Commerce of the United States is held in Washington February 3, 4 and 5.

The subjects of the Federal reserve act in relation to trade expansion, the development of the merchant marine of the United States, the Federal trade commission, rural credits, work of the Bureau of Foreign and Domestic Commerce, trade expansion and the European war, trust legislation and related topics are discussed by the recognized experts in these matters. One evening is devoted to an address by President Wilson.

The American Concrete Institute meets February 9 to 12 in connection with the Chicago Cement Show. A full program of papers on concrete roads, curbs, bridges, culverts, wall columns and beams, stands, stadiums and bowls, bins, sewer pipe, concrete surfaces, reinforced concrete in buildings and various large and small structures, plants and forms for handling and placing forms, properties of cement, fireproof construction and architectural expression in concrete has been arranged

The National Civic Federation has issued a "Memorandum of Suggestions" upon main provisions requisite to an adequate compulsory workmen's compensation law.

The National Conference on City Planning, Flavel Shurtleff, secretary, 19 Congress street, Boston, Mass., now has five volumes of proceedings of annual conferences which can be obtained at $1.50 each for the first two and $2 each for the others, plus transportation charges. The organization also has published eight bulletins, for sale at 10 cents each, or $5 a hundred, except one, for which the charge is 30 cents. The 1915 conference will be held in Detroit.

The American Wood Preservers' Association at its Chicago convention, January 19-21, sustained its reputation for valuable papers and discussions, one of which will be found elsewhere in this number. F. J. Angier, B. & O. R. R., Baltimore, Md., is the efficient secretary.

The Minnesota Snrveyors and Engineers Society will meet in St. Paul, February 19 and 20. Geo. H. Merrold, City Hall, St. Paul, secretary.

Resolutions demanding a combined meeting of the American Highway Association and the American Road Builders' Association were drawn up and signed by twenty-five of the leading exhibitors at the Chicago Road Show. The resolutions read: "Resolved, that unless the American Highway Association and the American Road Builders' Association agree to combine upon one time and place for the holding of a single annual meeting national road congress, we, the undersigned manufacturers, positively agree to make no exhibits whatever at any national road congress." It is expected by those adopting the resolutions that all the exhibitors will support the measure. A factor which contributed to the success of the convention from the exhibitor's standpoint was that to a great extent the visitors lived in communities interested in hard-surfaced roads.

The meeting of the New England Water Works Association at the Hotel Brunswick, Boston, Mass., February 10, has for its principal feature discussions of the reports of the committees on meter rates and on filter statistics. Willard Kent, secretary, Narragansett Pier, R. I.

Technical Schools.

The University of Michigan, Ann Arbor, Mich., issues a booklet of 20 pp. descriptive of the full courses in highway engineering carried on during the entire year. A short course will be held during the week of February 15.

The Yearbook of the Michigan College of Mines, Houghton, Mich., contains the schedule of courses and full information about the school and its facilities.

Recent lecturers before the Columbia University graduate school of highway engineering were Edward D. Boyer, expert of the Atlas Portland Cement Company, on "The Construction and Maintenance of Cement Concrete Pavements"; William A. Howell, engineer of streets and highways, Newark, N. J., on "Specification for Physical Properties of Paving Bricks and Stone Blocks"; Nelson P. Lewis, chief engineer New York Board of Estimate and Apportionment, on "Planning of Streets and Street Systems"; C. N. Forrest, chief chemist Barber Asphalt Paving Company, Maurer, N. J., on "Production of Bermudez and Trinidad Asphalts."

The short course in Highway Engineering to be held at the University of Illinois January 11-22, was postponed owing to the danger of spreading the foot and mouth disease now epidemic in Illinois.

The Case School of Applied Science, Cleveland, O., followed the prevailing fashion with a short course on highway engineering January 18 to 26.

In University Extension Bulletin No. 8, prepared under the Bureau of Municipal Information of the University of Iowa, Iowa City, is a collection of "Water Statistics of 38 Cities of Iowa with the Meter Rates of 70 Cities," by John H. Dunlap.

The January list of lecturers before the Columbia University graduate school included Walter H. Fulweiler, chief chemist, United Gas Improvement Company, Philadelphia, Pa., on "Manufacture of Water Gas Tar"; Philip P. Sharples, chief chemist, Barret Mfg. Co., New York, on "Chemistry, Manufacture and Testing of Refined Coal Tars and Methods of Trans-

portation"; W. W. Crosby, chief engineer, Maryland Geological and Economic Survey, and consulting engineer, Baltimore, Md., on "Preliminary Investigations in Highway Engineering, Value and Methods Employed"; William H. Connel, chief of Bureau of Highways and Street Cleaning, Philadelphia, Pa., on "Special Features in Street Cleaning Work, Snow Removal and Annual Municipal Clean-up Week."

Civil Service Examinations.

The United States Civil Service Commission will hold examinations at the usual places as follows:

February 10: Aeronautical mechanical engineer in Signal Corps Aviation School at San Diego, Cal., at $2,400 a year.

February 24-5: Hull draftsman under Chief of Engineers, U. S. War Dept., at $1,800 a year.

March 10: Aid and laboratory apprentice, Bureau of Standards; aid, and computer, Coast and Geodetic Survey; assistant examiner, Patent Office; copyist typographic draftsman, topographic draftsman, junior chemist, statistical clerk, departmental service; junior engineer, Engineer Department at large; superintendent of construction, Supervising Architect's Office; surveyor, Philippine service.

April 14: Civil engineer and draftsman; computer, Nautical Office and Naval Observatory; copyist ship draftsman, Navy Department; mechanical draftsman, and topographic draftsman, Panama Canal service; engineer, Indian service; junior mining engineer, Bureau of Mines; laboratory assistant, Bureau of Standards.

The Illinois State Civil Service Commission holds examinations at 15 places on February 6 for assistant utilities engineer at $90 a month, increasing to $125. Also on March for junior engineer under the State Highway Commission at $75 a month, increasing to $100.

Personal Notes.

Jos. F. Barton is the new mayor of North Yakima, Wash., which has had the commission form of government for three years, this being the second election. He is the superintendent of the department of public safety. Wilbur Crocker, superintendent of finance and accounting, and Harry Coonse, superintendent of streets and public improvements, are re-elected and chosen for their positions by the commission. The election followed a primary in which there were four candidates for nomination for mayor and seven for commisisoners, reduced to two and four respectively for the second election.

The city commissioners of North Yakima, Wash., have appointed for terms of three years Leonard O. Meigs as city attorney, Benjamin F. McCurdy as chief of police, N. A. Gilman as city engineer, E. G. Dawson as fire chief.

E. B. Van de Greyn has opened offices at 725 Chronicle building, Houston, Tex., for practice as a consulting and constructing engineer, devoting himself particularly to municipal and sanitary engineering, including drainage, irrigation and bridges.

F. V. P. Ellsworth, formerly city engineer of Hot Springs, Ark., is now assistant city engineer of San Antonio, Tex., in charge of paving.

Hazen, Whipple & Fuller is the new name of the firm, made by adding W. E. Fuller. Water works, sewerage, sewage disposal and drainage are their lines of practice, and their offices are at 30 East 42d street, New York City.

Charles Henry Davis, South Yarmouth, Mass., and Fred J. Miller, New York, are two engineers recently appointed members of the Simplified Spelling Board.

George W. Lawson, for some years with the Union Oil Company of California, will hereafter represent the Standard Oil Company of New Jersey and their Standard paving asphalt, made from Mexican asphaltic petroleum. He will also have a high-grade California asphalt. M. A. Giff will be associated with him in his new venture. Their offices are at 1451 Railway Exchange, Chicago, Ill.

Frederick C. Noble, M. Am. Soc. C. E., has opened an office at 50 Church street, New York, for consulting practice.

James R. Valk has been appointed western sales manager for the United States Asphalt Refining Company, with offices in the Harris Trust Building, Chicago, Ill.

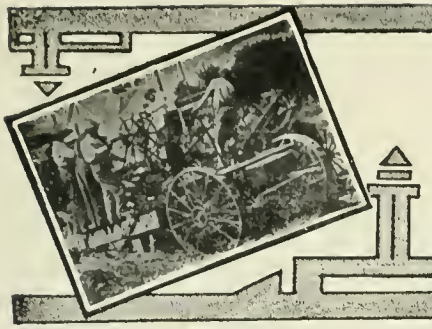
Publications Received.

Studies on the Silver Votameter are contained in No. 240 of the Scientific Papers of the Bureau of Standards, U. S. Department of Commerce, Washington, D. C.

Report on industrial wastes from the stockyards and Packingtown in Chicago, made to the Board of Trustees of the Sanitary District of Chicago by Geo. M. Wisner, chief engineer; Langdon Pearse, division engineer; Arthur Lederer, chemist; L. C. Whittemore, resident engineer. Paper, 346 pp.

Annual report of the Smithsonian Institution for 1913, Charles D. Walcott, secretary, Washington, D. C. Cloth, 804 pp.

Annual report of the U. S. Secretary of Commerce, Washington, D. C., for 1914. Paper, 214 pp.



MACHINERY AND SUPPLIES

A Snow Plow For Street Use

In these days of heavy snowfall the Twentieth Century snow plow, sidewalk and gutter cleaner is a machine of much interest. It is a snow plow, throwing snow in either direction, as it may be set, which cuts down to the pavement beneath, leaving it practically clean. There are one-horse and two-horse plows or graders, which can be used to clear sidewalks, gutters or street car tracks or to throw snow into windrows for removal by wagons. In one town it saved one-third the cost of cleaning cross-walks of snow by hand. In another northern Minnesota town, with heavy snowfall, one man with team and plow kept clear seven miles of sidewalks, six feet wide.

All the levers for handling the machine are in direct reach of hand or foot of the driver on his seat.

By changing blades the machine can be used as a mud scraper, ice scraper, stone spreader, ditcher and road grader as well as snow plow.

The Baker Manufacturing Co., Springfield, Ill., will give full details on application.

Sand Spreader for Pavements

City officials who are troubled with slippery streets, so common at this season of the year, should examine the Kindling sand spreader, which will cover such pavements with a thin, uniform layer of sand or gravel. Some cities try to cure slippery streets by hand-spreading of sand and some are prevented from trying this method because of lack of funds to meet the expense. The Kindling sand spreader will sprinkle 50,000 square yards of pavement per hour with sand or gravel, doing the work of fifteen or twenty men. Some materials will scatter farther than others, but this spreader will cover at least 20 feet with any suitable material, and from 50 to 60 feet with others. A lever regulates the flow of sand or gravel and the rate of scattering, and the driver operates the lever, so that but one man is needed.

Any materials from the finest sand to 1¼-inch stone can be handled by the machine. It is made by the Kindling Machinery Co., Milwaukee, Wis., the well-known makers of the Kindling squeegee for scrubbing city pavements.

Medusa Waterproofing Patent Sustained

The United States Court of Appeals, Seventh Circuit, rendered a decision on January 4, 1915, fully affirming the decision of the United States District Court, Northern District of Illinois, rendered February 13, 1914, by which the Newberry patent No. 851247 was declared to be good and valid, and that the McCormick Waterproof Portland Cement Co. infringed said patent. This is the patent on Medusa water-proofing for cement, made by the Sandusky Portland Cement Co., Sandusky, Ohio.

Old Block of Concrete from Panama Canal at Chicago Cement Show.

A cube of the first concrete made by the old French Canal Company in 1886 has been received in Chicago for exhibition by the Universal Portland Cement Company at the eighth annual Chicago Cement Show, February 9 to 16, in the Coliseum.

Altho the old concrete was formed in blocks like cut stone and not made monolithic, as in all the later construction, its endurance under severe weather conditions is remarkable. The materials used were a portland cement, Bohio rock and Panama beach sand.

In quoting the specifications under which this concrete was made Colonel Geothals says: "The Bohio rock is volcanic agglomerate of rather low specific gravity and medium hardness, but very resistant to atmospheric weathering. Dur-

ing severe "northers" the breakers have, sometimes, been strong enough to roll the blocks upon the beach." The French records of the contract of 1886, under which these blocks were made, contain the following specifications:

"Stone to pass through a ring 0.06 m. diameter, and to be washed and screened to eliminate all particles smaller than 0.02 m. diameter. The cement mortar to be composed of 800 kilogrammes of cement to 1 cubic meter of sand. These materials to be mixed dry upon a wooden platform under a roof, and water to be added by means of a sprinkling hose, taking care to use only as much water as may be necessary to produce a homogeneous mortar, which will stick to the shovel. The concrete to be composed of two parts of mortar and three of stone. After the mortar shall have been mixed as specified above, add the stone and mix with an iron hoe, until all of the stone shall be completely covered with mortar: the mixing to be accomplished without further addition to water, the stone, however, to be watered carefully in the pile at least one hour before using. The concrete to be dumped into forms and compressed to a compact mass. Repeated ramming to be carefully avoided."

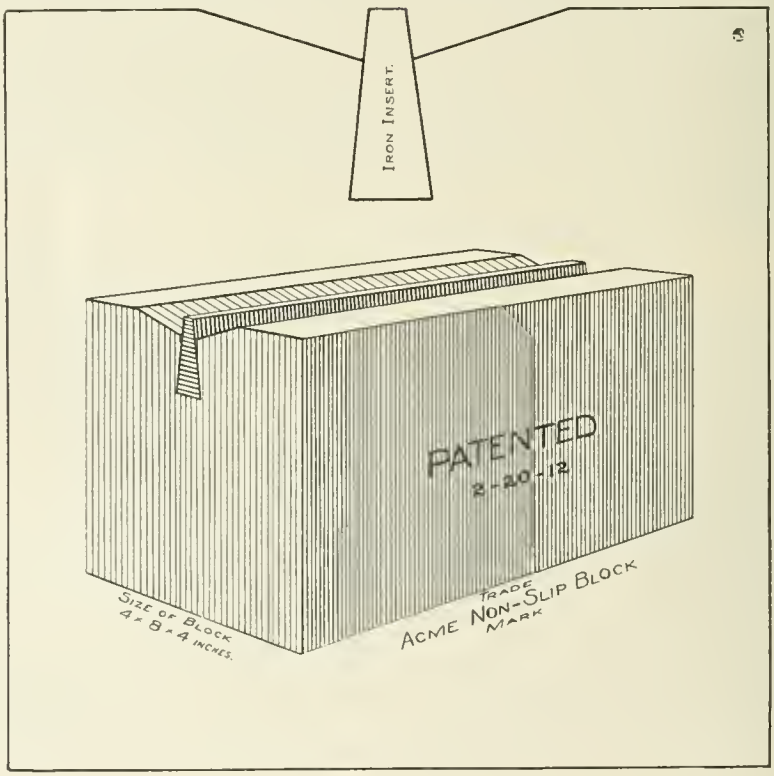
A Non-Slip Wood Paving Block

A type of wood paving which has been laid successfully in Boston and Philadelphia is designed to prevent the slipperiness complained of in certain wet or icy weather when a pavement is laid of rectangular creosoted wood blocks with smooth surfaces and close joints.

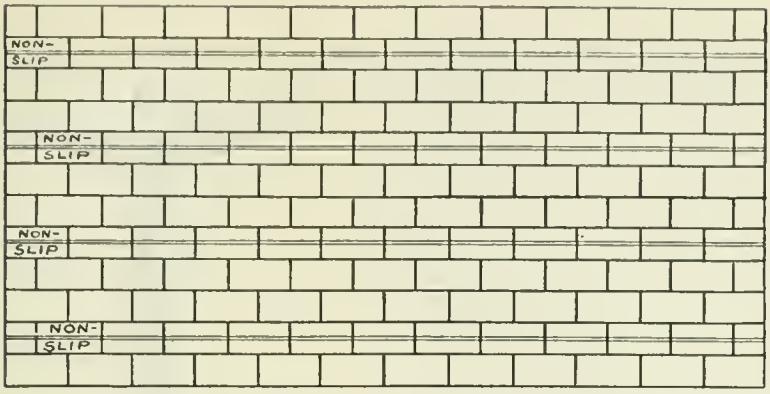
One of the accompanying drawings shows by its outside line the full-sized end of a block, from which it will be seen that its distinctive feature is a hollow in the upper surface with a re-entrant groove, in which is inserted an iron bar of trapezoidal section.

The inner drawing is an isometric projection of a completed block showing the special characteristics still more fully.

The blocks have been laid on two streets in Boston, where they have been in use for over three years. The pavement on Washington street, Dorchester district, is on rather heavy grade. More than 50,000 of the non-slip blocks were



NON-SLIP WOOD PAVING BLOCKS *with inserted steel strip. Outside line shows exact size and shape.*



NON-SLIP WOOD PAVING BLOCK *pavement, showing one row of non-slip blocks to two rows of common blocks.*

used on this street. The advantage to horses in preventing slipping are obvious, as they can secure firm, solid hold in pulling up grades. On a Philadelphia pier the blocks give horses the same advantage in starting heavy loads.

The second drawing shows the method of laying, the rows of blocks being laid perpendicular to the length of the street and non-slip blocks being used in every third row. Where deemed necessary they can be used in every second row.

As it takes forty 4 by 8-inch blocks to lay a square yard of pavement, 13 1/3 non-slip blocks and 26 2/3 plain blocks will be required for a square yard laid as shown in the design. If the non-slip blocks are laid in every second course half the blocks will be non-slip, and if in every fourth course one-fourth the blocks will be of the non-slip design. These blocks are, of course, more expensive than the plain creosoted blocks and the number of courses between courses of non-slip blocks will be chosen according to the necessities of the case as to accommodation of traffic on one side and as to cost on the other.

The Acme non-slip wood paving block is put on the market by the Philadelphia Wood Paving Block Company, Philadelphia, Pa., who will answer questions regarding them.

How Goodrich Tire Makers Went to War

War, and its effect on the tire industry of Europe, is graphically described by Arthur Lumsden, general manager of the French and English auxiliaries of the B. F. Goodrich Company, of Akron, Ohio, in a recent number of *The Automobile*.

"Our men had been paid as usual at noon on the Saturday France mobilized her army," Mr. Lumsden says. "At 4:30 o'clock the notices were issued putting the nation on a war basis. As our pay list is made up on Wednesday evening, arrangements were made for the cashier to be at the office on Sunday morning at 5 o'clock, in order that the men who were going to the front could collect their arrears of wages. In this way every man who left our works to go on active service went away fully paid.

"On Monday morning I was curious to see what the conditions would be at the factory. We found we had eighty men who were not eligible for active service. These men included most of those engaged in the band tire department. According to a previous arrangement with the French government, this department went under military control automatically as soon as war was declared, and we were put under an obligation to produce certain quantities of tires for army trucks." (This arrangement, it should be explained, is a part of the French army subsidy scheme. A couple of years ago Goodrich tires were admitted as part of the equipment of army subsidy trucks. Only the fact that the Goodrich company actually manufactures in France and has on its French board of directors men who have military responsibilities under the French law enabled this arrangement to be made.)

"London and Paris were violently panicky as soon as war broke out. The leading French tire firm, doing an immense business in England, called in all its stocks and refused to do business on anything but strictly cash terms. This move was followed immediately by the leading English firm. Dealers were decidedly annoyed at this action on the part of the heads of the French and English tire in-

dustry and expressed their dissatisfaction so forcibly that at the end of a couple of weeks the English company resumed business on the original basis. The curious feature of the situation is that both these companies took advantage of the patriotic wave, announcing 'Business as Usual,' 'Follow the Flag,' 'Stand by the Old Country,' 'Support British and French Industries,' etc.

"Practically our entire stock of tires, both at the factory and at the Paris stores, was requisitioned by the government. These tires were left in our hands, but could not be sold to the public, the army having the right to call for them at a moment's notice and pay for them according to a pre-established tariff, which is practically the price paid by dealers. There was no interruption in the production of band tires for trucks, but practically all we produced were taken up by the army. The strict regulations under which we have existed for a couple of months have been somewhat relaxed of late. We have been able to begin, on a small scale, the production of pneumatic tires, and also to offer some of our stock to the public. It is expected that within a few days arrangements will be completed whereby we can export to England, and thereby supply the European countries not involved in the war. We have continued to do a certain amount of business with those parts of France not occupied by the armies, but the difficulty here has been the lack of shipping facilities. We have never experienced any difficulties with regard to the supplies of raw rubber and fabric."

Street Sign Post

The accompanying drawing shows a very simple and comparatively inexpensive street sign post which has been introduced by the Enameled Steel Sign Company, 222 North State street, Chicago, Ill. This post is intended for use in parkways or lawns along the curbs of streets, and is one of several designs for various purposes and locations which the company has made.

The post is an angle-iron bar 2½ by 2½ by 3/16 inches, of the proper length to hold the signs 7 or 8 feet above ground, and to attach the anchors underground at depth enough, 30 inches, to keep the post upright against ordinary action of frost and shocks less than a runaway team or an automobile would give.

The signs are of enameled steel of the quality for which this company is known, and are simply attached to the flanges of the angle iron.

The bottom of the post is flattened and turned at a right angle to give a wide

horizontal flange. A 3/16-inch triangular plate is riveted to one flange of the angle iron and a brace to the other as shown in the drawing. If deemed necessary this base can be set in concrete to protect the post from rust and to give it more weight and stability.

This post is now in satisfactory use in Gary Ind. It costs $1.90 in lots of 100 or $1.70 in lots of 200. Further information will be given by the company above referred to if desired.

Corrugated Iron Culverts Convenient of Removal

These American ingot iron culverts offer all the advantages of the most approved culverts, with the additional merit of being light and easily transported to the place of installation, no matter how inaccessible.

They are most easily and quickly placed in position, and do not require the services of skilled labor. There is no element of chance connected with the use of these culverts, because there is no uncertainty as to them. There can not possibly be any question of structural weakness, inaccuracy of labor, defective materials. They can not come to you chipped in transit or with broken flanges. Coming in any required length or diameter, they may be placed in position with none of the difficulties incident to setting of joints with cement grouts, bracing against slipping and sliding while the joints are hardening, or any such common difficulties.

They possess another advantage not to be had in connection with the use of any other culvert material, namely, removability. By this we mean that these culverts may be taken out and reset, as may be desired when the grades of the roads are changed or the location of culverts is to be altered. There is nothing about them that requires any element of destruction, breakage, disconnection of attachment, or other sources of uncertainty, risk or complicated labor. For the private place, the farm, the park, or the public institution, summer resort, or cemetery, "Armco" culverts are peculiarly well adapted, inasmuch as such places are subject to frequent changes of landscape treatment, road and driveway construction and extension and the like. The lightness and inexpensiveness of this material renders it indispensable for these purposes.

For storm drainage of city streets a special form can be used, saving head room, but not at the expense of strength. This is the part-circle culvert of the National Corrugated Culvert Co., an example of which from Douglas, Ariz., is shown in the accompanying photograph. This culvert has a 78-inch base and 34-inch rise and carries storm water only.

PART-CIRCLE CULVERT *of corrugated in Douglas, Ariz., 78 inches by 34 inches.*

The Proper Care of Lawns

The season for caring for lawns, golf courses and the like is at hand, and park and other officials should investigate and secure the best machinery for the purpose. The Velvetlawn line of grass and

clover drills and seeders, both hand and horse drawn, is worth investigation. The Velvetlawn Seeder Co., Springfield, Ohio, will send on request a booklet on the proper care of lawns, as well as catalog and price list.

Universal Portland Cement Company at the Eighth Chicago Cement Show

Practice in the field of concrete construction progresses so rapidly from year to year that the Universal Portland Cement Company annually avails itself of the offortunity for presenting new ideas at the Chicago Cement shows.

REMOVING SLAB OF CONCRETE *from Bellefontaine, Ohio, pavement for exhibition purposes.*

Much space in the eighth Chicago Cement Show will be devoted to showing the need for clean sand, stone and water, properly graded and selected aggregate and the need for thoro mixing and curing of floors, block, and tile. Various types of cement products properly made and cured will show the strength and water-tightness obtainable with good concrete. Specimens of factory floors cast in three sections will indicate good and bad methods of construction.

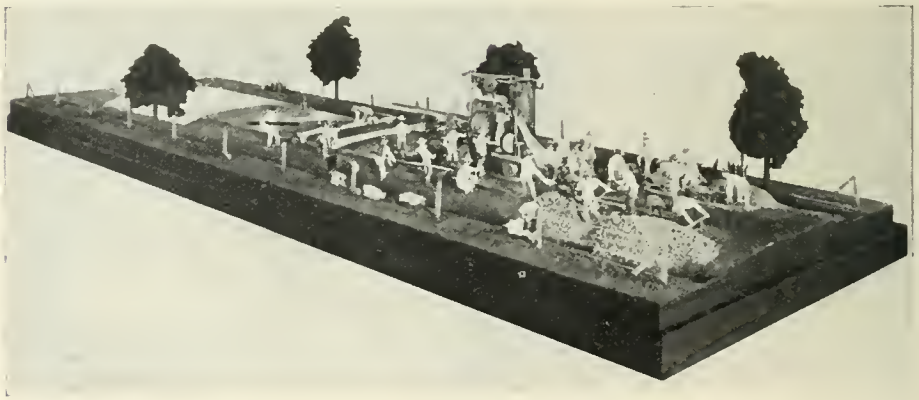
The good roads exhibit will include a model of a concrete road under construction showing the position of the mixer and the distribution of the working force. All details involved in the construction will be shown, including a section of the old dirt road upon which the concrete road is placed, a finished section of the concrete road itself, dirt covering for curing, stone shoulders along the finished section, pipe line for supplying water for mixing and sprinkling, and all the machinery and implements.

A section of the Bellefontaine, Ohio, pavement, laid in 1894, will be shown again. The original specifications for this pavement show many points of similarity with present-day best practice. A section of pavement from Woodward avenue, Wayne County (Detroit), Michigan, which was removed to permit making a suitable joint with the new Seven-Mile road, recently completed, will also be shown.

One of the many advantages of concrete roads is the fact that this type of pavement permits of building the concrete curb integral with the pavement itself. Charts show the usual construction, and others the approved practice of concrete paving between street car tracks.

On Twenty-first street, near the lake, is a two-course reinforced concrete pavement built to carry heavy traffic. From 1908 to 1913, a total of 129,744 square yards of concrete alley pavements were laid in Chicago. In 1914 alone the yard-

MODEL OF CONCRETE ROAD *under construction which will be a prominent feature of the exhibition.*



TWO-COURSE PAVEMENT *for heavy traffic on Twenty-first street, near the lake, Chicago.*

age approximated 125,000. Immediately outside of the city limits are many excellent types of country concrete roads.

One space will be devoted to the fireproofness of concrete. Its central feature will consist of transparencies showing the most striking scenes at the Edison fire, around which will be grouped smaller transparencies showing several pictures of this conflagration. Accompanying this will be an illuminated letter from Mr. Edison indicating his attitude toward concrete, his plans for rebuilding in concrete and an expression of his satisfaction in the manner in which his buildings stood up during the severe conflagration. The Salem fire will be treated in a somewhat similar manner.

The booth devoted to a portrayal of old concrete specimens will contain sections of concrete from Pompeii, Rome and Colon. A piece of concrete cut from a Nova Scotia bridge pier, cast in 1884 and subjected to tidal action ever since, will show how well concrete withstands such severe tests. Of less historical interest but of equal value in showing the permanence of concrete are sections of a street crossing laid in a North Dakota town in 1864, and used continuously for 30 years, a concrete block with granite facing subject to about 10 years of weathering, a 47-year-old piece of sewer pipe from South Bend, Ind., and a piece of sewer pipe from Bay City, Mich., more than 45 years old.

Concrete on the farm, in the garden, in decorations, will be shown. The economy of bulk cement will be demonstrated in one exhibit.

SECTION OF 45-YEAR-OLD CONCRETE PIPE *removed from Bay City, Mich., sewer to permit enlarging it.*

The Complete Workshop

Among the recent innovations calculated to arouse the interest of the educational world is a new workshop bench, known as "The Complete Workshop."

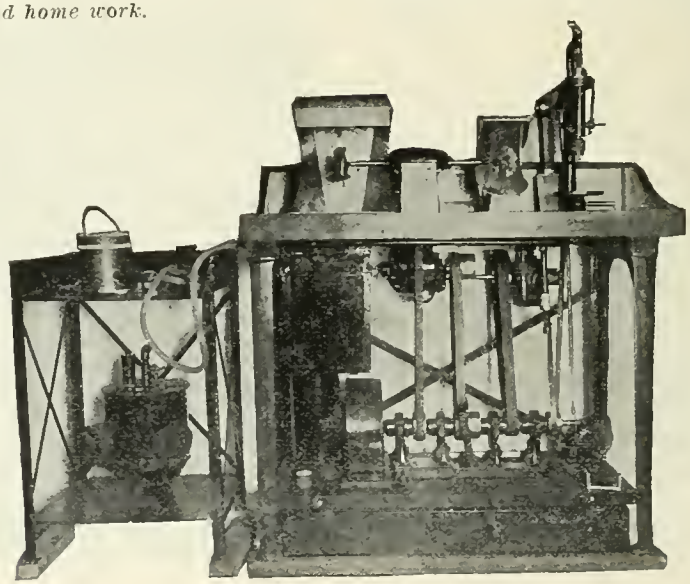
Almost every instructor has felt the need at some time or other of a small shop suitable for doing almost any kind of work, but in a great many cases space or the high rental cost of additional space forbids the installation of the necessary machines. The Complete Workshop has been designed for the purpose of obviating these difficulties, and making it possible to do all sorts of work in the educational line within the most limited space. Within a space slightly larger than the ordinary laboratory work bench would occupy are facilities for repairing and manufacturing which heretofore have required many times this space. The outfit is quite as well adapted for small manufacturing or repair work in connection with workshop or salesroom.

The polishing-dust collecting outfit forming the main part of this machine is exceedingly useful, not to say essential in the make-up of every workshop in the educational line, and especially to a shop connected with an ordinary salesroom or retail store. The use of this machine makes it possible to have the stock always looking fresh and bright by preventing the dust and dirt from flying all over the place. When repair work is done that requires buffing, the small particles of precious metals which are removed in this operation do not float away thru the air, but are drawn in by the powerful suction of air at both of the hoods, shown in the illustration, and deposited in the tank underneath the bench to be recovered subsequently and refined. Heretofore this material has been a total loss, but now it is possible to retain it and recover its value in new gold or other precious metals.

The drilling machine which is fitted with a high-grade chuck is capable of accommodating drills from 0 up to 5/16 inch. On the under side of the bench and fastened thereto is a pressure blower with the necessary pipe connections running over to the left-hand side of the bench, where arrangements are made to connect the air supply to the furnace, as shown on the iron stand alongside the bench, or in its place the sand blast shown underneath the furnace may be connected and used whenever required. It will be noted that all of these machines are connected by belts to the shafting shown on the lower platform, which in turn is operated by the motor hanging underneath the bench.

The motor supplied can be attached to electric lighting socket, and will give ample power to drive either of the individual machines, and is so arranged as to make it possible to operate them individually. The furnace table, as shown, is a separate table, which can be placed at the side of the polishing machine, or at any other part of the room. In this latter case it will only be necessary to increase the length of hose to carry the air.

The suction on the dust collecting outfit



COMPLETE WORKSHOP *for use in small shops or stores, for educational purposes and home work.*

is so arranged that by an arrangement of dampers an increased suction may be secured at either hood, according to the one that is being used. It will be noted that the machine is supplied with a small dust hood on one side, which may be used for small work, while on the other side a larger hood is shown, which is utilized when larger pieces are to be buffed.

The polishing head shown may be fitted with chucks for different purposes, such as sawing, turning, lapping and other operations.

The shaft bearings of the machine are self-lubricating, as also are the bearings of the pressure blower and motor. The bench is zinc-lined, so that it is easily kept clean, and the entire outfit may be operated from an ordinary electric light socket.

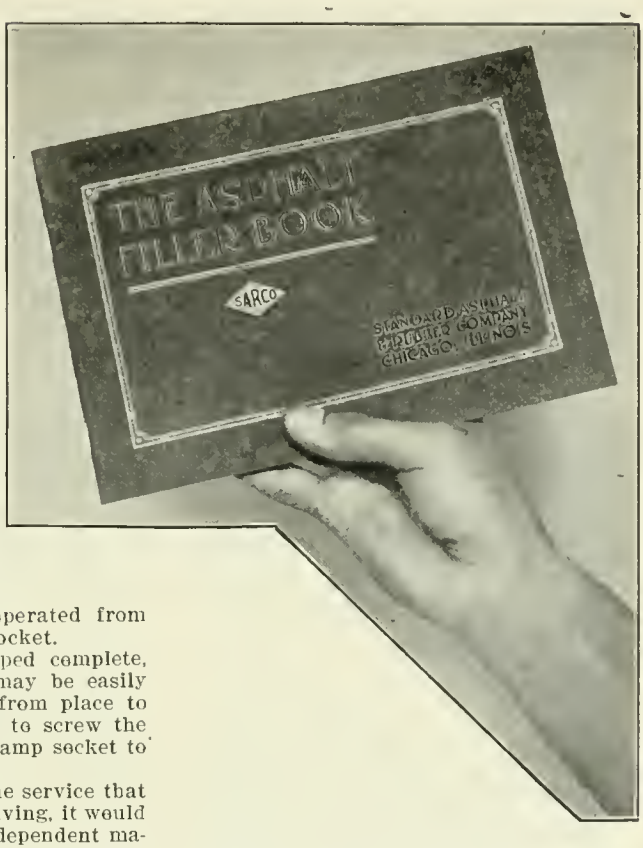
The entire outfit is shipped complete, set up ready to run, and may be easily handled and moved about from place to place. It is only necessary to screw the electric light plug into the lamp socket to begin work.

In order to secure the same service that this machine is capable of giving, it would be necessary to purchase independent machines which would cost a great deal more than this combination outfit costs, and it might be mentioned here that the cost of the outfit is very reasonable, so that a great demand is looked for among retailers, and especially among small repair shops.

The outfit is adapted for those doing small work as well as for educational work, and all of the different parts which are supplied with the machine are standard, well-constructed machines, and not in any sense experimental. The entire machine is substantially built and nicely finished, and its cost is very reasonable. The manufacturers of the outfit, Leiman Bros., 62 John street, New York City, will supply any additional information and prices for the outfit, which is the result of their twenty odd years of experience in manufacturing machinery.

Asphalt Filler for Brick Pavements.

The "Asphalt Filler Book," the outside of which is shown in the accompanying photograph, gives full information about the use of Sarco asphalt as filler for block



pavements. Specifications for fillers for various kinds of blocks and the various methods of applying them are fully stated. The quality of the service rendered by the booklet can be judged by the extracts from it made in the department, "From Workers in the Field," elsewhere in this volume.

Fiber Conduits

In the process of manufacturing Orangeburg fiber conduit wet wood pulp or fiber is wrapped in a minutely thin film upon a forming mandrel, under pressure, until the desired thickness of wall is obtained. The individual fibers become felted and form a solid, homogeneous wall. Taken off the mandrel, the wet pulp structure is subjected to a drying process, after which it is placed in a vat of liquid compound. This compound is a preservative and is also insulating and water-proofing. It thoroly permeates the entire structure, so that after treatment the wall of the conduit, when cut, presents a strong resemblance to hard rubber. The ends are cut in a lathe to make a socket joint,

sleeve joint or screw thread, as may be desired.

The same materials and general process are employed in producing bends of various degrees and radii, "S" bends, tees, elbows, crosses, couplings and junction boxes, with the varying number of outlets.

Stock on hand is stored winter and summer in the open yards of the manufacturing plant, the manufacturers thus demonstrating their confidence in the quality of the water-proofing and the perfection of the resistance of their product to the weather.

The third edition of the catalog of the Fibre Conduit Co., Orangeburg, N. Y., shows the many methods of installing the conduit pipes in the construction of multiple conduit lines for electric wires and cables. It also shows special uses for which the Orangeburg conduit is fitted on account of its resistance to corrosion by acids, weather, etc., and its strength, such as leaders to carry water from roofs, wall bushing for carrying cable and the like thru walls, conveying dilute acids, alkali or corrosive salt solutions, vinegar, etc., chemical containers, laboratory hoods and drainage channels, etc.

Single House Sewage Disposal.

Isolated country houses are sometimes confronted with the problem of sewage disposal, especially in these days when water supplies are ample, thru the use of wind mills or gasoline engines for lifting water, and the comfort of the dwellers in the house is duly considered.

Suburban houses to which the city sewer systems have not been extended, tho water pipes have reached them from the city supply, are in even more urgent need of a local method of disposing of sewage.

There are many small towns which have ample water supplies, but which have not yet had sufficient demand to warrant the construction of sewer systems because of the long lines necessary to reach all the residences and the consequent excessive expense.

All these classes of houses need residential sewage disposal plants. Quite a number of engineers design such plants upon request and have met with success in such practices. One of the engineers longest devoting himself to this kind of work and having one among the largest lists of successful plants to his credit is Burton J. Ashley, who, some years since, devised a simple and comparatively inexpensive plant, which he keeps fully up to date. The Ashley Sewage Disposal Company, Morgan Park, Chicago, Ill., is prepared to design and install such plants with full knowledge of the varieties of conditions met with, so that they should be able to meet any demands made upon them.

The Wonderful Growth in Wood Block Paving

By E. W. Church, Philadelphia, Pa.

Wood paving blocks, as we know them to-day, were but little used prior to 1900. A few cities had put down trial sections of wood block paving, but in each case the local engineer had worked out his own plan, no scientific data being available at that time.

From 1900 to 1908 the gain in wood block pavement was slow, the cities adopting this kind of pavement with great caution, but at the latter date the city engineers began quite generally to exchange data, and in consequence found that the laying of wood block pavement need not be wholly an experiment.

During 1908 some thirty cities laid wood block pavements, the amount laid in that year being about 800,000 square yards. From then until now there has been a constant increase in this pavement, and we find at the beginning of this year 150 cities using the wood block pavement, the amount so far laid being fully 10,000,000 square yards.

While there is much yet to be learned regarding treatment of blocks, method of laying, etc., the city engineers can now quite accurately determine the kind of wood best adapted, the proper amount of creosote saturation per cubic foot, and the best method of laying.

Ten million square yards of wood block pavement means that we have used up for this purpose practically 400,000,000 feet of merchantable lumber. At least 50,000,000 feet of lumber will be used up in wood block pavements during 1915. This brings us face to face with the great problem of to-day: The conservation of our timber.

Trade Notes

Among the contracts recently awarded to the Raymond Concrete Pile Co. are concrete piles for the foundation of a new power house for the Victor Talking Machine Co., Camden, N. J., and reinforced concrete ore trestle for the Maryland Steel Co., Sparrows Point, Md.

The Bessemer Limestone Co., Youngstown, O., sends a wall calendar for 1915 which cannot fail to find a conspicuous place in any office receiving it.

The International Engineering Congress will be held in connection with the Panama-Pacific Exposition at San Francisco, September 20-25. Memberships and subscriptions to the volumes of proceed-

ings are now being received by the secretary of the congress, Foxcroft Building, San Frnacisco, Cal.

Marconi trans-oceanic wireless telegraph is now in successful operation between San Francisco and Honolulu and has caused a reduction in cable rates to the basis of its own rate of 25 cents a word.

The F. D. Cummer & Son Company have just been awarded contract by the Boro of the Bronx, New York City, for a Cummer road plant with a guaranteed capacity for turning out 750 square yards of 2-inch top asphalt macadam or Topeka mix per day. This plant is to be erected ready for operation in the early spring.

The MacArthur Concrete Pile & Foundation Company, New York, has been awarded contracts for the foundation of the boiler house at the Portland (Me.) Gas Light Company plant; for pedestal concrete pile foundation for the State Hospital laundry building, Toledo, Ohio; for concrete piles required for the bridge over the Susquehanna river at Nanticoke, Pa.; for the foundation of the United States government post office building, Augusta, Ga. Waldo Bros., 45 Batterymarch street, Boston, Mass., have been appointed their sales agents for New England.

The Westport Paving Brick Company of Baltimore, Md., and the Mack Manufacturing Company of New Cumberland, W. Va., have become licensees of the Dunn Wire-Cutting Brick Company for the manufacture of wire-cut-lug paving brick.

Trade Publications

Ornamental concrete lighting standards for artistic illumination of business and residential streets, parks, private grounds, etc., are handsomely illustrated in a circular of Morrison & Quinn, manufacturers, Rochester, N. Y.

Connersville cycloidal pumps are the subjects of Catalog 16 of the Connersville Blower, Co., Connersville, Ind.

The Society for Electrical Development has prepared a booklet on electricity in the home, which can be used by its members as advertising literature to promote the use of the many household appliances now on the market.

A new booklet on "Disposal of Waste by Fire" can be obtained of the Atkinson-Morse Destructor Co., 30 Church street, New York City.

The American Rolling Mill Co., Middletown, O., sends a booklet of reproductions of letters giving expressions of the estimate placed on Armco-American ingot iron by those who are using it, which demonstrates the popularity and success of this specially pure iron for the purposes described.

The American Telephone Fire Alarm Co. has developed a fire-alarm system which is revolutionizing the alarm section of fire prevention. Its simplicity and ease of operation and maintenance are unsurpassed. It is described in full in the publications of the company, which will be sent on request from their office, 10 South La Salle street, Chicago, Ill.

Catalog 805 of the Studebaker Company is devoted to bottom dump wagons and dump boxes, of which this company makes a line which has long been the standard. The catalog goes into full detail of all parts and all designs and styles, and will be sent on application to the company at South Bend, Ind., or to any of its numerous branches.

A treatise on steam boilers and boiler feed water is issued by the American Boiler Life Co., Boston, Mass.

The Armco Culvert Publicity Bureau, 2101 Union Central Life building, Cincinnati, O., publishes an excellent article on "Corrugated Iron Construction on the Sacramento Valley Irrigation Project," which is by Eugene C. Mills, engineer of the Sacramento Valley Irrigation Co., which will be sent on request.

The Foster valve specialties of the Foster Engineering Company, Newark, N. J., are fully shown, listed and priced in Catalog No. 20.

Indiana Limestone, "the aristocrat of building materials," is the title of a handsome descriptive booklet, fully illustrated, issued by the Indiana Limestone Quarrymen's Association, of Bedford and Bloomington, Ind.

Sauerman Bros., Chicago, Ill., issue a fully-illustrated booklet on the Shearer and Mayer dragline cable way excavator, which seems to be one of the most popular of the excavators of this type now on the market.

The Harris Patents Company, New York, issue a catalog of a valveless engine which has some points of notable advantage.

The monthly publication of the Sandusky Portland Cement Co., always has descriptions and photographs of interesting architectural and engineering works in which Medusa portland or white cement has been used.

Willis Shaw Machinery Co., New York Life building, Chicago, Ill., publish a semi-annual booklet of second-hand machinery which they have for sale.

The Burt Portland Cement Co., Bellevue, Mich., publish daily tests of their cement for a week in August, which show some remarkable results as to uniformity.

G. H. Atkinson Co,, New York, issue an illustrated description of a nesting galvanized street cleaning can and a push cart or can carrier for the use of the street cleaner with broom or brush and pan or shovel.

A new folder shows the latest product of T. L. Smith & Co., Milwaukee, the Smith mixerette, which takes a batch of 5 cubic feet of loose sand, stone and cement and mixes 40 to 60 cubic yards of concrete per day.

It required a panoramic photograph 6 by 36 inches, crowded full of faces, to show those present at the general sales conference of the Goodyear Tire and Rubber Co., at Akron, O., on October 30.

A recent booklet of the Sandusky Portland Cement Co., Sandusky, O., is a handsomely illustrated demonstration of the wide and successful use of Medusa waterproofing, manufactured by this company for The Medusa Waterproofing Co.

Catalog 58 B of The Van Dorn Iron Works Co., Cleveland, O., is a fully illustrated exposition of their systems of steel jail and prison cells, keyless locking device for sliding cell doors and interlocked and counterlocked grating construction.

G. H. Atkinson Co., 30 Church St., New York, have a new circular regarding their "Torpedo" scarifier for road surfaces.

The Koehring Machine Co.'s Chicago district manager is out with a hurry-up circular on "War with the Elements," giving the advantages of hurrying up fall work with a Koehring mixer.

The United States Tent & Awning Company, Chicago, has a new catalog and price list of all sorts and sizes of tents, balloons, chairs, seats, benches, tables, lights, cots, flags, oiled clothing and other goods for outdoor use.

The embargo on crude rubber from English possessions has been raised thru negotiations with the English government by the government of the United States and representatives of the manufacturing companies, and new shipments have begun to arrive, with consequent reduction in price of rubber and protection of prices for tires.

The Sandusky Portland Cement Company, Sandusky, Ohio, is distributing an edition in Spanish of its booklet on Medusa White Portland Cement.

A booklet illustrating and describing the processes of making Youngstown quality pipe, lap and butt welded wrought iron, is issued by the Youngstown (Ohio) Sheet and Tube Company.

The Van Dorn Iron Works Company, Cleveland, Ohio, have at least two lines of manufacture of interest to public officials. One of these is their patent prison and cell construction, using their toolproof steel; another is strong and ornamental fencing for parks, enclosures for animals, bear pits, etc., some of which have been illustrated in MUNICIPAL ENGINEERING. Catalogs and booklets on each line will be sent on request.

Small destructor furnaces for disposing of the wastes from hospitals, department stores, factories, private estates and small cities and towns are built by the Atkinson-Morse Company, 30 Church streets, New York City, who will send booklets descriptive of the same on request.

The Buckeye Engine Company, Salem, Ohio, issue a booklet about their compact steam engine and boiler for contracted space. They claim for their designs of power plants half the coal, half the floor space and half the labor of many other steam plants. They also make gas engines and the Buckeye-mobile.

Much of the Grinnell Automatic Sprinkler Bulletin for January is taken up with the story of the fire in the Edison plant and how it might have been saved by the use of automatic sprinklers.

The Reid incinerator is briefly described in a booklet by the A. H. Reid Incinerator Company, 69 Rowanwood avenue, Toronto, Ont.

Clifford Richardson, New York, has published in a booklet a brief article on "Stone-Filled Asphalt Surface or Fine Asphalt Concrete."

The Koehring mixer booklet for January has been received from the Koehring Machine Company, Wilwaukee, Wis.

The Universal Portland Cement Company, Chicago, Ill., publishes a handsomely illustrated series of booklets on Concrete Roads which gives much valuable information.

Standard reinforced spiral pipe is detailed in catalog No. 4 of the Standard Spiral Pipe Works, Chicago, Ill.

The Blackmer & Post Piper sounds the merits of Blackmer & Post vitrified pipe, made in St. Louis, Mo.

The Red Book of the United States Gypsum Company, Chicago, Ill., will be mailed on request to any one wishing full, authoritative information on gypsum and its products, such as wall plaster.

Studebaker catalog 914 describes street sprinklers and sweepers, of which this company makes a standard line.

DeLaval centrifugal pumps, single and multiple stage, for all capacities and heads, are fully detailed in catalog B of the DeLaval Steam Turbine Company, Trenton, N. J., which sets forth their characteristics, design, manufacture, testing, selection and adaptation to various uses. Thre are special chapters on speed-reducing gears and turbine-driven water works pumps.

The third annual message of Rudolph Blankenburg, mayor of Philadelphia, and the department reports take three volumes, the first covering public safety and the civil service commission; the second public works, clocks and city transit; and the third, public health, supplies and other departments. The report just issued is for the year 1913.

MUNICIPAL ENGINEERING

The World's Leading Municipal Publication.

AUTOMOBILES IN THE MILWAUKEE WATER WORKS DEPARTMENT.

VOL. XLVIII. MARCH, 1915. No. 3.

The engineer's code of ethics can be comprised in a single sentence like this: "Act as a gentleman in every respect on all occasions; be just and generous to your brothers in the profession and do not hesitate to take the full responsibility for all your actions."—W. HILDENBRAND.

Published by

Engineering Publishing Co.

INDIANAPOLIS, IND.

New York Office:
1127 World Bldg.
GEO. H. CLINGAN,
Eastern Mgr.

Chicago Office:
1634 Marquette Bldg.
E. D. POWELL,
Western Mgr.

Entered at Postoffice, Indianapolis, as Second-Class Matter.

A. P. Fox, President. **C. C. Brown, Editor.** **C. S. Sale, Gen'l Mgr.**

Subscriptioo Price in U. S. and Possessions, Cuba and Mexico, $2.00. Canada, $2.40. Foreigo, $2.75.

Changes of address, subscriptions, remittances and editorial matter should be addressed to MUNICIPAL ENGINEERING, Indianapolis, Ind.

THE JITNEY BUS

A NEW PROBLEM IN TRAFFIC REGULATION.

By Frank Reed, Los Angeles, Cal.

The jitney bus has spread like wild-fire over the country during the past six months and has become a serious problem in street traffic regulation, a nuisance at the same time that it gives a large measure of benefit to the patient strap-hanger who now, sometimes, can get a seat and make better time all at once. Probably the acute stage will be passed as times improve and other employment offers and as old cars wear out and their owners have not been able to make enough to buy others, but evidently there is a permanent use for the jitneys under some conditions in some places and at some times of day, the times of greatest congestion in street traffic. The problem of regulation will therefore not be so serious as it appears at this time. Up to the date of going to press no regulating laws or ordinances have actually been passed and put into force.

THE "jitney bus" is a contagious municipal affliction now in violent eruption on the streets of a constantly increasing number of cities. Its symptoms are well defined. First is the appearance of a rapidly increasing number of heterogeneous motor vehicles, usually worn or second-hand, and of the low-priced pleasure-car type, driven by men with an unkempt and worried appearance, who, by their activities, soon come to be known as "nickel chasers." The term "jitney" is slang for five cents, the price of a ride.

The next symptom is frequent irresponsible driving, an outgrowth of competition with one another, and with street cars, and a tendency to be careless of the rights and privileges in the streets of pedestrians, particularly persons intending to board electric railway cars. This recklessness and frequent defective condition of automobile equipment or ignorance of driving, together with traffic congestion, result in a notable increase of street accidents due to contacts between vehicles and pedestrians, or between vehicles and stationary objects or other vehicles.

The third stage is protest by the established electric railway companies against the "irresponsible and unregulated competition" of the jitney motor transportation, which, with all its defects, appeals to a very considerable riding public. Then comes the laying off of cars and curtailment of service on certain lines most affected by the jitney bus competition.

The next stage is active newspaper publicity and general public discussion of the good and ill aspects of jitney bus transportation, resulting in a demand for regulation. By this time the jitney bus drivers are formed into an organization and issues become fairly well defined, but bitterly contested, making regulation without precedents a difficult problem.

Los Angeles has been doing the heavy pioneering in working toward a solution of the jitney bus problem. The jitney bus originated in Phoenix, and was a good thing there, operating on streets not covered by electric railway service. Next it was heard of in Long Beach, where, in certain sections of the city, it supplemented with a needed transportation service the existing electric railway service, and then it was discovered that a $5 a month license would turn over to the

TYPICAL JITNEY BUS *in use in Los Angeles, with sign. Note length of route.*

driver of a pleasure car in Los Angeles the privilege of peddling transportation, or soliciting riders, and operating between the heart of the business district and the principal residential sections along the level asphalt boulevards. There was a rush stimulated by lack of employment of automobile owners who had previously been working as salesmen, solicitors, collectors, etc., and also by the heavy number of cars in the second-hand market in a city where an average of one family in every five is an automobile owner.

The automobile dealers declare the jitney bus is a business anomaly—a business failure that is bound to stay. It is a business failure because only rarely can the operator peddle enough rides in a day to pay the operating and repair costs of his car, make an adequate allowance for the depreciation of the vehicle and pay himself a reasonable living wage on a 5-cent fare. The drivers, speaking generally, admit this themselves. What they are really doing is selling the residue value in old cars to the public in nickel installments, living on their cars, if they are their own, or making a bare living above the installments on the cars if they are bought on time from a second-hand dealer, until they can get some kind of a steady job. The men in the automobile trade point out that this kind of people and this kind of cars and conditions will be found in some cities all the time, and that as fast as one goes out of the jitney business his place will be taken by another. Of course the railways, being most hurt, are making the loudest protest. Unemployment of their men is created about as fast as employment is acquired by others in the jitney business.

The jitney drivers do not give a predetermined and regular service, either as to route or time schedule. It is urged that this will affect real estate values unfavorably.

The appearance of the jitney bus traffic in the business district produces an unfavorable impression on the average onlooker, which has led to objection by leading retail stores and hotels, and other business men. The street congestion is inconvenient and frequently dangerous to pedestrians at crossings, and to drivers of automobiles engaged in what automobile dealers and owners call legitimate use of the machine.

Jitney drivers early discovered that the money was in the overload, and the machines are crowded to a degree which can only be compared to the Brooklyn bridge crush in the old days. Little extra seats of board are installed in tonneaus, and in the rush hours passengers ride on the

doors and the running boards. Twelve in a five-passenger Ford is no uncommon sight: a situation which has led to discussion of the need of regulation on social grounds.

Congestion in the downtown blocks of the principal business streets is augmented by the establishment of safety zones at car-boarding points, which were rendered absolutely necessary by this new traffic. There is a general impression that the limit of street efficiency is exceeded by the addition of the jitney, of which over a thousand are now licensed in Los Angeles.

On the other hand, the jitney is being used by some thousands of passengers daily. Many of these are picked up in a moment of indecision by an alert nickel chaser, who drives up to the curb as they are waiting for a street car, opens his door and, as it were, scoops them into his car. Many others ride by choice. The chief attractions of the service are that it is a ride in an automobile with upholstered seats on automobile springs above rubber tires over smooth asphalt pavement; that the jitney acquires its load quickly, and most of the people unload near together, and there are comparatively few passengers per car anyway, so it gives an express service as compared with the frequent pick-up and let-down stops of the electric railway cars. Jitneys give fifteen minutes from some outlying districts, as against thirty for the electric car. Even when the tonneau is crowded there is some kind of a thing to sit on or lean upon for everybody, and as to the crowding, it is sufficient to remark that some people like a rough-house time anyway. So it appears that, however much electric railway people dislike it, the problem which confronts a municipality when the jitney comes is not one of elimination, or absolute suppression, but of regulation.

Probably the first consideration is that of street efficiency. This is tied up more or less with the question of what is a safe load for a jitney, and this in turn is rendered doubtful by the variety of types of vehicle. Light motor trucks, with bodies having a seating capacity of ten or fourteen pasengers, are coming into use to some extent, and pay better returns than other types.

The present tendency in regulation thought seems to be to permit but one

TAKING THE LAST WEAR *out of an old automobile by using it as a picker-up of transportation nickels.*

rider with the driver on the front seat, no riding on the running board, and to limit the load in the tonneau to two above its seating capacity.

Results of a brief study of traffic efficiency, under electric and jitney transportation, respectively, of the high-class business block in which the heaviest congestion occurs in Los Angeles, on Broadway between Sixth and Seventh streets, supply the following data: The length of the block, including crossings from outside of curbs, is 612 feet, width 56 feet from curb to curb. It is traversed lengthwise by double electric car tracks; electric cars cross at Sixth street and at Seventh, and there is a double track turn-off on some of the heaviest lines in town from Broadway to West Seventh. Safety zones are established by portable sign stands at the car-stop end of the block on each side, leaving room for one automobile to pass between the safety zone and the sidewalk.

During a heavy rush hour for all kinds of traffic, the street is packed full of automobiles and electric cars, with the congestion piling up and extending behind. Figures which show the reason for this and give a basis for comparison with

IT IS THE OVERLOAD *which seems to bring the profit, but excessive wear and breakages will soon tell a different tale.*

figures which may be obtained in other cities, so that an estimate of the effect of a given district, are as follows:

Center entrance cars seating 50 are 46 introducing jitney bus traffic, may be made from a consideration of the street space and persons traveling to and from feet 7 inches long by 8 feet 5½ inches wide. Pay-as-you-enter cars seating 42 are 2 feet shorter. Figuring on the comfortable standing capacity, at the ratio of 66 seats per 100 passengers, determined as reasonable for the rush hour in a noted decision of the Wisconsin Railroad Commission, these cars should carry 75 and 63 passengers respectively in the rush hours. Twelve of the larger cars, the capacity of one track in the block, would load 792 passengers. Allowing longitudinal street space of 13½ feet for a Ford jitney, and figuring 7 passengers to the vehicle, not including the driver, the block full of jitneys, on one side in a single string, would load 45 with 315 passengers. As the jitneys are inter-

spersed with privately operated automobiles, the paid traffic transportation cacapity load of a block for electric car traffic is somewhere around four times the efficiency of the block for jitney traffic. If the jitneys were left to carry the traffic alone, they would smother one another out of business, or compel the building of subways.

The street railway companies insist that they cannot continue to operate if the jitneys are to skim the cream, that is, the rush hour and best route traffic, which makes up for the long empty hauls which regulatory ordinances force upon the electric cars.

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¶ THE CONGESTION OF TRAFFIC *is measured by the actual count of vehicles now necessary to carry the crowds and of capacity of the autos commonly used as jitneys.*

November 27, 1914, a traffic count at Seventh and Broadway, from 5 p. m. to 6:30 p. m., showed 345 cars passing that corner. Vehicles of all kinds, 1,533. Passengers on electric railway cars going out of town, 8,227. Cars going out of town, 191. Average load per car, 43. To transport the passengers carried by the cars would require 1,177 Ford automobiles carrying 7 passengers per auto, not including the driver. Allowing street space of 13½ feet per vehicle, which is 2 feet in excess of actual space covered, would make a string 3 miles long. Constant operation would require an incoming string of machines 3 miles long to keep up the procession, after the first 3 miles had loaded and passed out of town. To carry out of the city all the people the electric railway transports, in Fords at 7 per car, would make a line of jitney busses between 35 and 40 miles in length going, and an equal line coming. The railway does this with 17 miles of cars.

The effect on safety of street travel produced by the introduction of the jitney bus is indicated by statistics of accidents in Los Angeles, which show a sharp increase coincident with the development of this new type of transportation. Street accidents had been running slightly less than 400 per month in July, August and September. In October the jitneys began to appear, and street accidents ran up to 463. In November, new jitneys were going on every day, until, at the end of the month, there were about 700 operating, and accidents showed a cumulative increase through the month to a total of 601. The first eight days of December there were 8 accidents per day traceable entirely to jitneys. In the period November 17 to 28, out of 280 total accidents, there were 111 due to jitneys, which were only 3 per cent. of total vehicles. Accidents averaged 14.9 per day in October, and 23.3 per day in the last two weeks of November, with jitneys involved in 26 per cent. of the total.

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¶ STREET ACCIDENTS *are greatly increased by the increase in traffic, the competition for passengers and irresponsible drivers.*

Lieutenant Butler, of the police traffic department, in his official report attributes this definitely to "incompetence or recklessness or both in a large percentage of drivers," and suggests rigid examination of drivers, prohibition of riding on running boards, and limiting of operations to a stated route.

Control of the jitneys by the State Railroad Commission is advocated in some quarters. Such control, under the existing public utility laws, would require them to file and operate on definite schedules and routes, and they might start operations only after proving that public convenience and necessity required them to operate over a contemplated route.

In Los Angeles the mayor covers the situation by advocating an ordinance which would take the jitneys out of the four main streets in the down-town business section, thru the congested blocks, leaving them to operate on the parallel streets immediately outside. He says they should be required to have definite starting and stopping points, and to make the full run every trip. Loading and unloading points should be apart from street car regulation stops. Rigid examination of applicants for license, license fee in

proportion to gross receipts, power to revoke the license for reckless driving and violation of traffic regulations, requirement that each auto bus take out from an insurance company of established reliability an indemnity bond of not less than $10,000, and that overloading should be strictly prohibited, are further measures advocated. The mayor refers to reports of Traffic Officer Butler, citing accident figures already quoted, and also to the warning of Fire Chief Eley, issued after his equipment had been delayed on the way to fires by jitney bus congestion.

Business men have petitioned the city council for a regulating ordinance, including fees of $60 a year for five-passenger cars up to $100 a year for fifteen or more capacity.

The entire situation is a new and exceedingly vital problem affecting municipal activities in several lines and public welfare, as well as the welfare of established public utilities which are heavy contributors to municipal and state revenues. The experience so far may be summed up in two principal conclusions. Operation of the jitney busses shows urgent need of careful and effective regulation, and further it has proved that automobiles cannot be operated with profit on a business basis in a general passenger transportation scheme on a flat five-cent fare, even without transfers.

[Editor's Note.]

The above article may be supplemented by a digest of the newspaper reports from other cities showing the popularity of the jitney bus, its apparent business impossibility, and, at the same time, its success, which is probably but temporary.

Not including such attempts to establish regular routes for auto-bus lines, successful or unsuccessful, as have been noted in Municipal Engineering from time to time, in New York City, where they succeeded the old Fifth avenue horse-drawn stages, Washington, Pittsburg, Indianapolis, Huntington, Ind., Los Angeles, Detroit and elsewhere, the first real jitney bus seems to have been started in Phoenix, Ariz., during a strike in 1913. It was followed in 1914 at Long Beach, a seaside resort of Los Angeles, and in October, 1914, by Los Angeles itself, as described by Mr. Reed, which city, by latest reports, has over 1,000 jitney busses in operation, taking in about $8,500 a day. The street railway company has petitioned the city council of Long Beach for permission to abandon about four miles of street car lines, which, it claims, do not pay in competition with the jitneys. The company has taken off about 40 cars from Los Angeles lines because of the reduction in traffic.

The street railways in Monterey and Pacific Grove, Cal., are reported to have been forced to the wall. Other cities followed rapidly, particularly on the Pacific Coast.

Houston, Tex., began about the middle of December and has developed over 200 cars, which have been taking $1,000 a day out of street railway fares, with an increase in number of accidents. Autos pay $1 license fee and file $100 bond to comply with city ordinances. The Jitney Association is trying to work out a regulating ordinance, in co-operation with the city council.

Seattle began a little later and now has over 500 autos in service, some of which run all night, with 10-cent fare after midnight. The Seattle Auto Transit Association has 300 members and has retained counsel to protect its interests in the Legislature. Autos pay $2 state tax and $4 city vehicle license. The State Public Service Commission recently decided that they are common carriers and subject to regulation by the commission.

San Francisco began early in January, now has over 1,000 cars in operation and expects 2,000 when the exposition traffic is developed. Regulations by city ordinance, by legislative act and by the State Railroad Commission are all in process. Oakland has 450 jitneys and an association of owners.

Fort Worth formed the Auto Transit Company about the middle of January, operating 30 cars, and individuals have

brought the number up to 141, paying no tax or license.

Kansas City began a few days later and has more than 100 in service on 27 routes, with service on some up to midnight. There are a few motor trucks in the service crudely equipped to carry 30 to 50 passengers. There is an association which is trying to develop routes and assignments to them.

In Birmingham, Ala., the first jitneys were started by a large auto dealer to put second-hand cars in use. Others have followed. Drivers report that a second auto on a route improves the traffic by giving better service, but a third makes it hard for all three to get enough to live on a line with a limited amount of traffic.

Ogden, Utah, has the Jitney Service Company, with $25,000 capital stock, and three lines.

The first jitney bus in Peoria, Ill., started February 8 and on the 10th rather short routes were in operation along three principal street car lines, and four cars were running to East Peoria. One of the city aldermen is in the firm starting the first lines with seven cars, and will try some long lines, possibly supplying larger cars, as small autos cannot pay on long lines. The taxicab company figures a loss on 5-cent fares and will not start lines. It figures 12 cents a mile for tires and gasoline on a 3,000-pound car, chauffeur's wages, deterioration, interest, license fee, oil, repairs and liability insurance, and demonstrates its contention. The jitney bus pays the regular hack license of the city.

St. Louis has a Motor Service Company which had 11 automobiles in the jitney service February 13 and added an auto truck carrying 30 passengers on that day. The jitneys carry about 2,000 passengers a day. The service of the company is increasing daily and 25 autos are probably in use by the time this number of MUNICIPAL ENGINEERING is issued. Some of them run only in the rush hours, morning and evening. The regular lines are comparatively short, 15 to 20 minutes time being required to cover them. A 10-cent line to the Art Museum was started February 14 to run until 8 p. m. with ten cars, two of which broke down the first Sunday, and the line carried 600 passengers during the day.

Omaha is reported to have started 10 routes on February 1.

Maryville, Mo., is a small city with a single jitney bus.

Conway, Ark., has one auto bus and two 5-passenger cars on regular schedule and route.

The mayor of Portland, Ore., thru his chauffeur and 7-passenger car tested a populous route, collecting $7.75, with an expense of $4.50, not including chauffeur's wages for twelve hours.

Oak Park, Ill., started a municipal jitney bus the last week in February, running on a route over two miles long. It seats twenty passengers and costs $9.50 a day to operate, including the cost of the lease of the vehicle, so that 190 fares a day will be necessary to pay expenses.

Terre Haute, Ind., started the jitneys early in February and on the 21st had forty-two in operation on all car lines running on paved streets. Operators report satisfactory results.

Milwaukee ($10 license); Denver, Spokane, Wash., with 25; Olympia, Vancouver; Portland, Ore., with 75; Des Moines, San Antonio, Oklahoma City, Joplin and Baltimore are other cities reported to have the service. The first one in Indianapolis started early in February. Cincinnati is reported to have organized a company with $250,000 capital.

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¶ GENERAL OBSERVATIONS *and conclusions are perhaps premature, but a few words may not be out of place.*

Receipts are reported to run as high as $15 a day, but the averages reported run $10 or less.

Short routes are the rule, tho the photograph of a Los Angeles jitney shows a sign indicating that its route is far from short.

In New York a year's experience with a law making auto-bus lines common carriers has convinced the Public Utilities Commission that the law subjecting them to commission regulation should be repealed. They say that "there seems to be no sound reason why any person or cor-

poration should not use the highways under proper regulations drawn by the highways department," and that the applications for permits take their time from more important matters. The Oregon legislature has refused to put the jitney busses under the control of the State Railroad Commission, the committee stating that the cities had full power to regulate their operation.

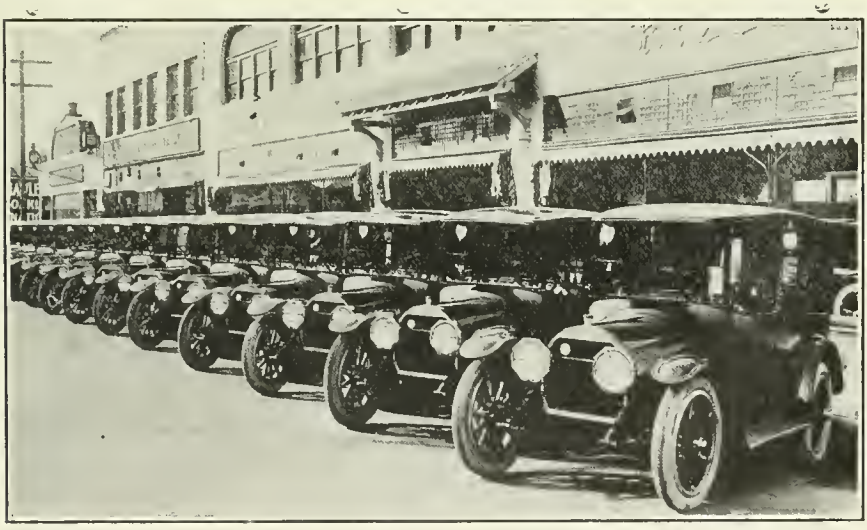
The Fifth avenue (New York) auto-bus lines are successful with 10-cent fare, largely because of the special features of the routes which attract custom and the special character of the regular traffic.

The lines in Indianapolis, intended to serve districts not well served by the street railway, failed to attract custom with a 10-cent fare, or enough to pay with a 5-cent fare, and when the fare was reduced to 25 tickets for $1, to compete with the street railway on equal terms, the receipts were reported to be sufficient for paying operating expenses, but not enough to make adequate provision for replacing worn-out vehicles.

Interurban bus lines in competition with electric railway lines are reported to be unsuccessful at Los Angeles and elsewhere. Suburban bus lines run by the Cleveland street railway where rail lines had not yet been extended were started last August, but have cost much more to operate than the receipts from them.

It seems probable, therefore, that the jitney busses will later drop out except on routes not otherwise more cheaply served. There would seem to be a field for them on such lines and in towns too small to attract a street railway. But, so long as there are cheap, second-hand cars to use up, for which there is no other use, and there is lack of employment for their owners, we are likely to have the jitney bus, regularly or sporadically, as conditions are favorable or unfavorable.

THIS PHOTOGRAPH *of a part of the fleet of Kissel limousine taxicabs purchased by the Los Angeles Transfer Company indicates that there are other systems of transportation still in operation in that city.*



A PROPOSED STREET LIGHTING CONTRACT

By Charles A. Tripp, Consulting Engineer, Indianapolis, Ind.

The improvements in street lighting are so numerous and so great at this time that the ordinary street lighting contract, unless made for too short a time for true economy, is not able to keep pace with them. The author of this article, an expert electrical engineer who has had much experience in making and in criticizing contracts between cities and public service corporations, offers a form of contract which seems to have the necessary flexibility and to secure to the city all the benefits of the advances in electric lighting that it wants and at the same time that it provides for proper compensation to the electric light company, neither too great nor too small.

THERE has been no time since the introduction of electric lighting when the future development of lamps has been as uncertain as it is today. The past six years has seen the advent of the metallized carbon, the tantalum, the tungsten, the nitrogen and the argon lamps in the incandescent field, the latter being placed on the market during the past month, resulting in a present current consumption of about one-eighth of that required by the carbon filament lamp of six years ago. Practically the same period has seen the introduction of the metallic flame arc lamp, followed by a rapid series of improvements and modifications, which have resulted in large gains in efficiency. The future development, even two or three years hence, is certainly beyond the realm of prediction at this time.

Considering this condition, it seems to us that the time has arrived when street lighting contracts between municipalities and public service companies should take a much more flexible form, one which will give the city an opportunity to take advantage of a new type of lamp whenever it desires and yet will protect the company against loss of investment through obsolescence, to an extent that the city can obtain a reasonable rate for the service.

The following contract is based on three divisions of the payment:

First—Current used.

Second—Depreciation and interest on investment.

Third—Maintenance.

Section 1—The said company hereby agrees to deliver to the street lights suitable and necessary current for the lamps installed and the said city hereby agrees to pay the company as full compensation for said current the price of ..... cents per kilowatt hour.

The said company shall furnish and maintain on its switchboard at its plant in said city the necessary watt-hour meters for measuring this current. These meters shall be connected to the lines on the secondary side of all transformers or current regulating devices. They shall be subject to inspection or test by representatives of the city at all reasonable times.

Under this section the company receives pay for the current actually used by the city, as it would in the case of any private consumer for light or power, at an agreed price per kilowatt hour. The current used by any new type of lamp,

or by lamps of different sizes, becomes a matter of no further concern to either party so far as their contract relations are concerned. The city pays for what it gets and the company receives pay for what it furnishes.

Section 2. The said company shall furnish and install street lights of such type or types and at such times and locations as the city may order. Upon the installation of such lamps the company shall render to the city a statement showing the cost of said lamp equipment. This cost shall include the lamp complete with the necessary fittings, hanger and lamp support, whether suspension cable, mast arm, or bracket, and the labor of installing the same, but shall not include the cost of any poles, current-carrying wires or generating equipment. The cost above referred to shall be the company's purchase price of material, plus all carriage charges and the actual amount paid for labor.

It is hereby mutually agreed that the said city shall pay the said company annually ..... per cent. of such statement, in twelve (12) equal monthly payments, for a period of ten (10) years. Such payments shall constitute a full reimbursement for all amortization, depreciation, obsolescence, interest and investment charges, and, after the expiration of the ten (10) year period, no further expense shall incur to the city for the use of said equipment.

If at any time the city desires to substitute a different type of lamp for any lamp or lamps then in use, or discontinue the use of any lamp, all of the remaining yearly installments upon such lamp equipment as is discontinued shall become due and be paid. Upon the installation of such new equipment a statement of cost shall be rendered to the city and payments on the same shall be made as above provided.

Unless a new contract is entered into between said city and said company at the time of the expiration of this contract, all of the remaining yearly installments upon the street lighting equipment shall become due and be paid, and the said equipment shall become the property of the city and may be removed by the city from the poles of the company.

This section gives the city an absolutely free hand in determining when any change shall be made in lamps, and yet protects the company fully in its investment. Whenever a lamp is developed which will produce a sufficient saving to the city in current to make it economical to abandon the old type, the city is free to make the change, without any argument as to price or modification of the existing contract.

Section 3. The said company shall take charge of the operation, maintenance and repair of all public street lights and shall render to the city a monthly bill covering the cost of all incandescent lamps used for renewals, electrodes for arc lamps, repair parts and glassware used during the previous month, plus ..... per cent. Such ..... per cent. shall be considered as reimbursement to the company for stock charges and for labor for maintenance and care of the lamps.

This section likewise is in such form that no additional agreement will be required for any change in the type, number or size of lamps. The company is responsible for the proper operation of the equipment, and receives pay for what it does. While the objection can be raised to this section that it produces a bill which it is difficult for the city to check, yet this carries small weight on account of the fact that the total item is a small one, and that most new types of lamp can be bought under a maintenance cost guarantee from the manufacturers.

NIDD VALLEY RESERVOIR

OF BRADFORD, ENGLAND, WATER WORKS.

THE city of Bradford, in Yorkshire, England, is the center of the woolen and worsted industry in England, and the imported wool from Australia, New Zealand and other places comes into the city in its raw state and requires washing and combing, hence the city requires a good supply of water to carry on successfully the chief industry.

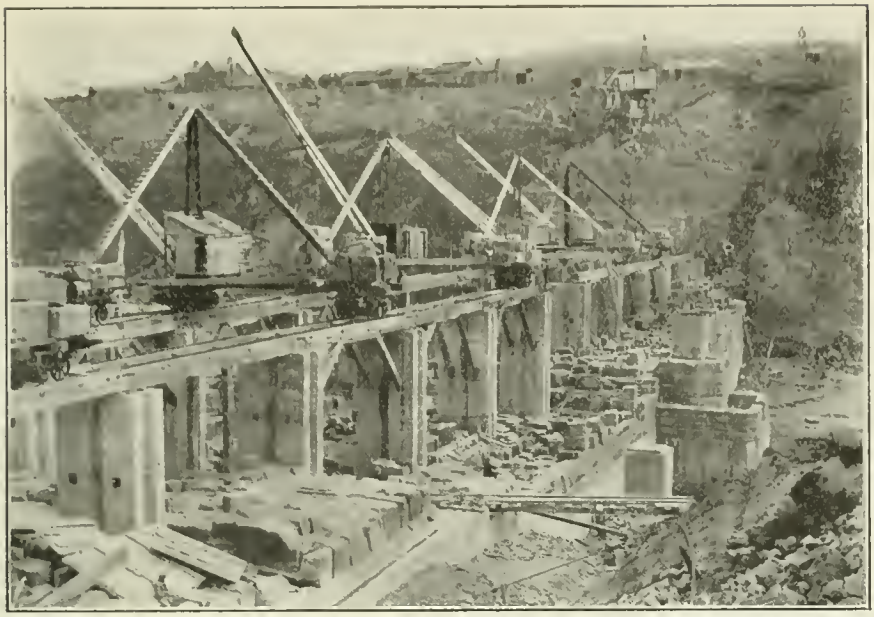
Besides supplying the needs for industry, the city provides water not only for itself but for twenty-five other towns outside. This demand is equal to 15,000,000 to 18,000,000 per day, in an area of over 120 square miles and a population of about half a million people.

To meet these demands the City Council had to seek powers to embark on the Nidd Valley water works scheme, which was designed by the city's water works engineer, James Watson, M. Inst. C. E. This scheme includes the Angram dam, which is situated some 32 miles away from the city. This dam is in course of construction, was commenced in 1904 and will require two or three years more to complete. The amount for this vast undertaking was about $1,400,000 (£365,495) and the amouut of concreting and masonry runs to 258,700 cubic yards.

The dam forms the first of the large storage reservoirs to be constructed in the Nidd Valley for the city's supply. The outflow of water is controlled by a valve tower built on the inner face of the dam. This valve tower, which has three inlets from the reservoir, is built of masonry and lined thruout with cast iron cylinders enclosing the valves, upstand pipes, deck plates, head stocks, etc., and the valves will be worked and operated by hydraulic pressure.

By-pass or waste-water channels have been constructed on each side of the dam for convenience in carrying out the work, keeping water from the foundations, etc., and for the purpose of carying flood water past the dam.

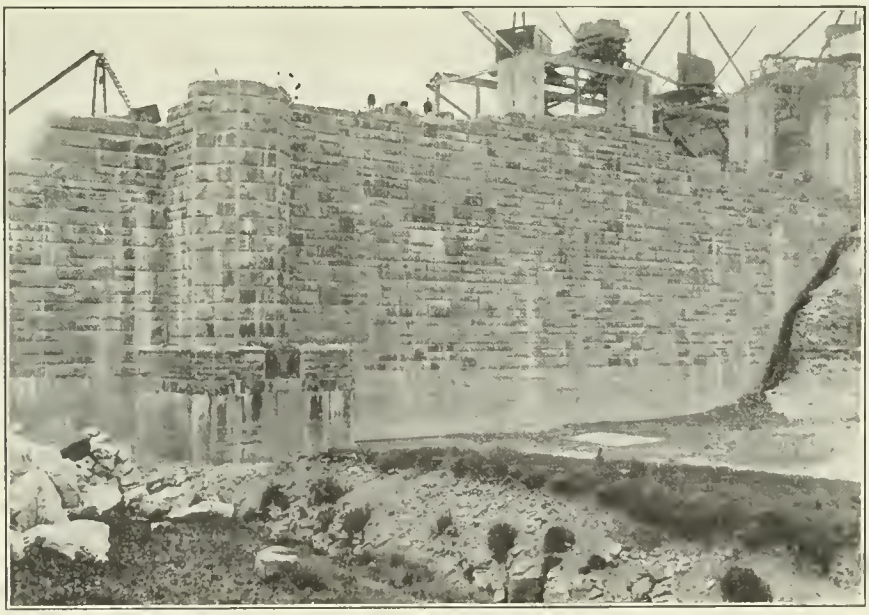
The concrete mixers on the works can turn out some 320 cubic yards of concrete per day and there are often 500 to 700 men employed on the works. For works of this magnitude the municipal authority has provided on the site a



METHOD OF CONSTRUCTION *of dam. Above, concrete piers, gravity cranes and tracks, and beginning of masonry face. Below, up-stream masonry face of dam, and inlet tower.*

school for the workers' children, a reading room for the workmen, and an infirmary with resident doctor and nurse.

The corporation, in order to cope with the immense quantities of material that would be required in the process of construction, built a railway some 13 miles in length, which is the only passenger railway in Great Britain coming under the power of a city or town council.



PUBLIC RECOGNITION OF PATENTS

By George C. Warren, Boston, Mass.

This article is the introduction to a lecture delivered by the author in the course of the Graduate School in Highway Engineering of Columbia University, and it states the principles upon which the issuing of patents is based so clearly and so fully that it is worthy of a prominent place in engineering literature on its own merits. The patent as a contract and as a monoply are discussed and legal decisions are quoted. State regulation of the use of patented articles is also fully considered.

AMONG the earliest and most world-wide and universally recognized economic governmental principles among civilized nations is one that it is to the interest of the public that, as an encouragement to "promote progress of useful arts," the inventor should, for a limited period, be given the exclusive right to use, manufacture and sell his invention and hold to himself and those who financially and otherwise assist him in its perfection and development, all profits which accrue therefrom—a legal monopoly or "patent." The principle is not only a world-wide national economic institution, but, in order that governments may secure the full benefits of the results of invention in other countries, it has become international and we have a treaty under the name "international convention," the chief feature of which is that application may be filed in any one or all of the other countries which are a party to the convention within twelve months after the filing of the first application in any convention country.

The countries which have joined in this international agreement or treaty with respect to issuance of patents are the United States, Austria, Hungary, Bosnia and Herzogovina, Belgium, Brazil, Cuba, Denmark and Faeroe Islands, Dominican Republic, France, Algeria and all French Colonies, Germany, Great Britain, Japan, Mexico, Norway, Dutch Indies, Surinam, Curacao, Portugal with the Azores and Madeira, Servia, Spain, Sweden, Switzerland, Tunis, Commonwealth of Australia, Italy, Netherlands and Guatemala.

In his "First Annual Address" to the "Fellow Citizens of the Senate and House of Representatives," dated January 8, 1790, President George Washington said:

"I cannot forbear intimating to you the expediency of giving effectual encouragement as well to the introduction of new and useful inventions from abroad as to the exertions of skill and genius in producing them at home."

From reply to this message by the Senate, dated January 11, 1790, the following is quoted:

"The introduction of new and useful inventions from abroad and the exertions of skill and genius in producing them at home * * * are objects which shall receive such early attention as their importance requires."

Sixty-four years later, President Franklin Pierce, realizing that the patent franchise, as it had at that time developed, was too narrow and did not offer sufficient encouragement to invention, in his message to Congress dated December 5, 1853, used these words:

"I commend to your favorable consideration the men of genius of our country, who, by their inventions and discoveries

in science and arts, have contributed largely to the improvement of the age without, in many instances, securing anything like an adequate reward. For many interesting details upon this subject I refer you to the appropriate reports and especially urge upon your early attention the apparently slight, but really important, modification of existing laws therein suggested."

It is certain that any individual, municipality or other community that refuses to use or purchase a patented article is seventeen years behind the times, for practically every invention of merit is patented and the patent does not expire for that period.

It is equally certain that any individual or community which undertakes to undermine a patent, after the patentee and his associates, by expenditure of large measures of brain, money and energy, have developed a market for his useful invention, is practicing a most unfair attitude not only toward the inventor, but toward the government which has adopted the patent system as an economic institution for the purpose of fostering and encouraging invention, which is essential to progress.

A community which does not invent is one which is centuries behind the times, and a country which does not foster inventions by patent franchise is a country in which there is little progress in industry, art or science from century to century.

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¶ THE PATENT FRANCHISE *is a contract of the government with the inventor for the benefit of the people as well as of the patentee.*

The patent franchise is not by any means a present from the government to the inventor, but is a carefully planned contract which in the United States has its foundation in the Federal constitution on which our government is based, an agreement between the government and the inventor with consideration on each side under which:

1. The inventor undertakes to:

(a) Perfect to a practical result an idea which it would not be worth expenditure of his time, energy and money to develop if the public was to have all the resulting benefits.

(b) To fully and publicly describe his invention so that, at the expiration of the patent, he will have dedicated to the public such full information regarding the invention, without trade secret reservations, as will enable one skilled in the art to prosecute the invention.

2. In consideration of the foregoing the government grants to the inventor the exclusive right to prosecute his invention for a limited term of years, which varies in different countries. In the United States the term was formerly fourteen years with a privilege of renewal for seven years more, making a total patent franchise term of twenty-one years. This was changed in 1861 to a flat term of seventeen years from the date of issue of the patent, with no right of renewal.

Here we have an evenly balanced, well considered contract, with clear-cut, definite and valuable consideration from each party to the other—the government representing the interests of the public on the one hand and the inventor on the other.

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¶ A PATENT *is not a true monopoly, tho it gives to its owner a certain control of the sale and use of the invention for a limited time.*

A patent is not a monopoly in that objectionable sense in which the term is generally used. Decisions of the highest court of our country tell us that it is such a monopoly as was expressly authorized by the constitution of the United States, and that Congress has enacted laws to promote improvements in the arts and sciences by securing to inventors for a limited term a monopoly of the right to make, use and vend their inventions. It has been universally conceded that these laws are highly beneficial. Years before the adoption of the constitution, the English Parliament, in the reign of King James, enacted a statute (21 Jac., Ch. 3) giving inventors exclusive rights for fourteen years.

The following citations from decisions of the Supreme Court of the United States

and quotations from standard text-books should uproot any impression that there is anything injurious to the public in the limited monopoly granted to inventors.

Extracts from United States Supreme Court Decisions.

"It is undeniably true, that the limited and temporary monopoly granted to inventors was never designed for their exclusive profit or advantage: the benefit of the public or community at large was another and doubtless the primary object in granting and securing that monopoly. This was at once the equivalent given by the public for benefits bestowed by the genius and meditations and skill of individuals, and the incentive to further efforts for the same important objects." *Kendall v. Winsor*, 21 How., 327.

"Letters Patent are not to be regarded as monopolies, created by the executive authority at the expense and to the prejudice of all the community except the persons therein named as patentees, but as public franchises granted to the inventors of new and useful improvements for the purpose of securing to them, as such inventors, for the limited term therein mentioned, the exclusive right and liberty to make and use and vend to others to be used their own inventions, as tending to promote the progress of science and the useful arts, and as matter of compensation to the inventors for their labor, toil and expense in making the inventions, and reducing the same to practice for the public benefit as contemplated by the constitution and sanctioned by the laws of Congress." *Seymour v. Osborne*, 11 Wall, 533.

In *Allen v. Hunter*, 6 McLean, 306, the Court, denying that patents are monopolies, said:

"The right of the patentee entirely rests on his invention or discovery of that which is useful and which was not known before. And the law gives him the exclusive use of the thing invented or discovered for a few years as a compensation for his 'ingenuity, labor and expense in producing it.' This, then, in no sense partakes of the character of a monopoly."

In *ex parte Robinson*, 4 Fisher, 186, Judge Davis said:

"The property in inventions exists by virtue of the laws of Congress, and no state has a right to interfere with its enjoyment, or to annex conditions to the grant. If the patentee complies with the law of Congress on the subject, he has the right to go into open market anywhere within the United States and sell his property."

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¶ STATES CAN REGULATE *use of patented articles, but cannot prohibit such use simply because they are patented.*

It is true the several states, in the exercise of their police power for the protection of the public health, safety and morals, have the right to regulate, within reasonable limits, the use of a patented article within their borders, if either of the above interests should be affected by its use, but no state has the right, directly or indirectly, to prohibit the use of any patented article simply because it is patented, unless its use can be construed to injure the public health, safety or morals.

Judge Brawley, a distinguished judge of the United States Circuit Court of Appeals, has said of patents:

"The protection and hope of profit, held out by our patent laws, inspires that stimulating energy which leads to experiment, invention and all the resulting benefits." *Crown Cork Co. v. Aluminum Co.*, 108 Fed. R., 870 (1901).

These opinions of the highest courts of the country suffice to show the favor with which the law regards patent rights. Is it believed to be right that an inventor should be persuaded to forego the rewards which a just and beneficent law of Congress has bestowed upon him in recompense for his years of toil?

In the case of *Kendall v. Winsor*, cited above, the Supreme Court said:

"But whilst inventors are bound to diligence and fairness in their dealings with the public, with reference to their discoveries, on the other hand they are by obligations equally strong entitled to protection against frauds or wrongs practiced to pirate from them the results of thought and labor, in which nearly a lifetime may have been exhausted; the fruits

of more than viginti annorum lucubrationes, which fruits are ultimately to gather."

It is no just criticism of either the principle of or results from the patent franchise to say that a very large percentage—certainly much more than half—of the patented inventions have so little practicable merit that little is heard from them after the patent is issued and that a smaller percentage fail after practical trial and the expenditure of a large amount of brain, energy and capital in development of the invention.

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¶ THE TELEPHONE, *the electric light, the wireless telegraph, have required years of time and millions of money to develop them, which could not have been expended if those making the improvements, as well as the original inventions, had not been protected during the lean years before they could be shown to be practical essentials in everyday life.*

Does any one suppose that either Prof. Bell, in the case of the telephone, or Dr. Edison, in the case of the electric light, and the hundreds of others operating with them in reducing their ideas to practical results, would or could have expended the years of patient effort and millions of money necessary to accomplish their magnificent results, if they had not seen ahead a compensating encouragement and reimbursement for their investments in time or money, which compensation was only possible through the granting and operation of the patent franchise?

It is well known that even with the encouragement offered by the patents, both the Edison and Bell companies passed through years of anxiety and nearly through bankruptcy before their inventions were a practical success, and the same may be said of nearly every invention which is sufficiently novel and sufficiently universal in its application to become a real factor in the world's progress. Calmly ask yourselves the questions: "Is the world indebted to Bell and Edison, or are they indebted to the world? What does it matter if they and their associates ultimately made millions before their patents had expired when, on the other side of the balance sheet, we see that we can converse between New York and Chicago as clearly as we can converse in this room, and that the clearest and most economical light is produced by chaining natural water power, converting it into electric current and transmitting the current often hundreds of miles, into our homes, offices and streets?" On the evening of January 25th it was demonstrated that conversation can be clearly carried on by telephone from Boston to San Francisco, over more than 3,200 miles of wire, and not only the words clearly understood but the voice recognized.

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¶ THE DEVELOPMENT *of the great inventions to their present practical values has been possible because of the patent system and its protection of the enormous investments necessary to make these developments and put them into use.*

On a recent visit to Arizona I was impressed with the magnitude of the hydro-electric power, heat and light development for which Dr. Edison is chiefly responsible. A few years ago that state was an arid desert. No vegetation—wood, coal nor oil. From the Roosevelt dam, developed by the government, in the northern part of the state, abundant water for irrigation is carried hundreds of miles, converting the desert into one of the most productive and diversified agricultural communities which any country of the world has ever produced. Coincident with this, from the same dam, power and electricity are developed which, thanks to the patented inventions of Edison and others, is carried hundreds of miles and supplies the universal heat and light required by the community at a fraction of the cost of any other heat and light because of the absolute absence, in that state, of the elements necessary to provide other forms of heat and light—coal, oil and wood.

I care not how many millions Edison and his associates may have made out of their patent franchises, the public in the single state of Arizona is making many times that amount by reason of those franchises. Another incident in Phoenix, Ariz.,: I wrote a telegram and was asked

by the hotel clerk if I wanted it sent by wire or wireless telegraph. Actually, Marconi is competing with the Western Union and Postal Telegraph companies in that state which, ten years ago, was a desert. Will any one claim that that development would have been a possibility if Marconi had not been granted patents covering his inventions? And so down the scale you may trace any and every successful patented invention add you will find the patentee has given more than he has received and, almost as universally, the invention would never have been perfected and developed if the encouragement of the patent franchise had not been granted by the government.

I have specially dwelt on the foregoing phase of the patent franchise because a considerable, and, I fear, a growing part of the community looks upon the patent as a sort of monopolistic graft which should not have been granted and which any one has a moral right to appropriate.

With equal certainty of not being caught, people who would not steal a horse will, without compunction, steal a patent although the investment of the owner is much greater in the patent than in the horse. Morally, one of the forms of theft is the same as the other. Legally, in the case of the horse, the thief goes to jail if caught, but, in the case of the patent, the law in effect says to the owner:

"You may litigate and in the end you will get recovery in damages, provided your pocketbook is long enough to stand the onslaught which your pilfering competitor wages on you."

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¶ THE COMMON CLAIM *that a simple and common idea has been patented when it deserved no such protection is disposed of by the courts, as in an English case here quoted.*

In an unusually important and interesting English patent infringement case, the *Edison Bell Phonograph Corporation Limited vs. Smith & Young* (Reports of Patent Cases, London, Volume 11, page 398), the Court of Appeals of Great Britain in discussing the impropriety of certain highly technical, tho common efforts of endeavoring to defeat patented inventions, which by practical development have proved to be of merit and general public utility, used the following forceful language:

"Whenever I hear the objection taken to a patent which has been used, which has been bought and sold, which has been therefore treated by men of business as a useful thing, that it is wanting in subject-matter, I look upon it, I confess, with an amused contempt.

"What is the meaning of want of subject-matter. It is not the same thing as want of invention, or rather I should say as want of novelty; it is not the same thing as want of utility, but, where you cannot maintain either of those propositions which would be sufficient to destroy the patent, it is something else, which some one or other, at some time, has invented as an idea for destroying patents. And what is it? It really comes to this, that, although the invention is new—that is, that nobody has thought of it before—and altho it is useful, yet, when you consider it, you come to the conclusion that it is so easy, so palpable, that everybody who thought for a moment would come to the same conclusion; or, in more homely language, hardly judicial, but rather businesslike, it comes to this, it is so easy that any fool could do it. Well, I look, as I say, upon that objection, when all others have failed, generally with amused contempt. It can be made, out, but hardly ever. When you find that which I have stated, it is hard to think that people would be buying and selling a thing—and that has been sometimes the whole thing—and yet the objection should he taken that it is wanting in subject-matter."

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¶ SUCCESS *where others have failed is often given in court decisions as evidence of patentability.*

Touching on the trend of the court cases where the patentee has produced a successful result where others, working along somewhat similar lines, had failed to accomplish that result, where, in other words, there is sufficiently close relation between the "prior publication" or other "disclosure" and the successful patented

result but producing the all-important difference between "failure and success" respectively, but sufficiently close relation to provide means for ingenious attorneys to wage a contest against the patent, the following extracts from important decisions are interesting:

"Inventors are not precluded by the embryonic and shapeless ideas found in former patents, any more than they are by such undeveloped matter existing elsewhere." (124 F., 486, *Canda vs. Michigan*).

"Courts incline to sustain a patent to the man who takes the final step in the invention which turns failure into success" (*The Barbed Wire Patent*, 143 U. S., 275).

"The great commercial success of a patented device may turn the scale on the question of invention in a doubtful case" (*Beckwith vs. Mallcable Iron Range Co.*, 174 F., 1001).

"The widespread commercial success of a patented device should be taken into consideration in determining the question of invention" (*Coffield Motor Washer Co. vs. Howe et al.*, 190 F., 42).

"The fact that as soon as a patented improvement was made and introduced, its advantages over devices which had preceded it became manifest at once, and it commended itself to the public as a practical and desirable improvement, affords a safer criterion of inventive novelty than any subsequent opinion of an expert or intuition of a judge" (*Palmer vs. Johnston*, 34 F., 326).

In *Expanded Metal Co. et al. vs. Bradford et al., etc.*, U. S. Sup. Ct. 143 O. G., 863, Mr. Justice Day says:

"It is often difficult to determine whether a given improvement is a mere mechanical advance or the result of the exercise of the creative faculty amounting to a meritorious invention. The fact that the invention seems simple after it is made does not determine the question; if this were the rule, many of the most beneficial patents would be stricken down. It may be safely said that if those skilled in the mechanical arts are working in a given field and have failed after repeated efforts to discover a certain new and useful improvement, he who first makes the discovery has done more than make the obvious improvement which would suggest itself to a mechanic skilled in the art, and is entitled to a protection as an inventor. There is nothing in the prior art that suggests the combined operation of the Golding patent in suit. It is perfectly well settled that a new combination of elements, old in themselves, but which produce a new and useful result, entitles the inventor to the protection of a patent" (*Loom Company vs. Higgins*, 105 U. S., 580-591).

"If our purpose was speculative, not practical, we might pause to wonder how such substances could produce such results under the conditions to which they are subjected, and by wondering we express in a way the quality of the invention. * * * We need not, however, dwell longer on the excellence of the invention. The government has testified to its excellence by using it in the guns intended for the national defense" (*United States vs Societe Anonyme des Amiens Etablissements Cail*, 178 O. G., 591).

TRAFFIC CONTROL

AT ELECTRIC RAILWAY CROSSINGS.

The electric railway can use the current from its own wires to operate audible and visible signals so that its problem of protection of crossings of its line with highways, steam railroads and tracks of its own or other electric railways is comparatively simple. In this article are described a signal system for a street railroad crossing on a busy city corner and automatic signal systems for highway crossings of interurban roads which have the advantage over ordinary railroad crossing signals of being visible as well as audible by night or day, and of showing to the motorman whether it is in operation.

RAILWAYS operated by electricity can use the electric current in operating signals at crossings with other railroads or at highway crossings so that they will not be subject to the breaks in service liable in battery systems. They can be either audible or visible or both and can be made automatic if desired.

The first of the accompanying illustrations shows a novel and practical street-traffic control system as installed at the intersection of Euclid avenue and East 105th street, on the Cleveland 3-cent-fare street railway system.

Electric lights are placed on the right-hand side of each street so as to face oncoming vehicles. A red light denotes stop and a green light proceed. The red light is placed on the near corner of the crossing and the green on the farther corner. The officer who controls the switch is stationed in a booth to the left in the accompanying illnstration. The sides of the booth are glass and this enables the officer to see traffic in all directions. The switch is so interlocked that it is impossible to give conflicting signals.

When traffic is opened in one direction it is automatically closed in the other direction. When an alarm is turned in at fire headquarters an instrument in the booth notifies the officer so that he may clear the crossing for the passage of the fire apparatus. After throwing an emergency switch which sounds an alarm bell and flashes red lights at all crossings, he is free to leave the booth and give his attention to the street.

The photograph is self-explanatory, tho a little study may be necessary to distinguish between the lights showing up and down Euclid avenue and those showing to 105th street.

A highway crossing protection has been installed on the Washington-Virginia Railway Company lines, with trolley-contact control adapted to the operating conditions. One of these has been in successful operation for a long period on a single track and two others on donble tracks have recently been installed.

At Clark station, on the Falls Church division, which is double track, the headway is 30 minutes during the day and 15 minutes in the evenings. Trains are run in sections, as many as four or five following each other closely. The highway crosses at right angles and at a considerable grade, but the view of the railway from the highway is obscured by trees, brush and a high bank on three of the corners.

The apparatus installed at this crossing consists of an iron pole having the sign, bell and relay attached to it, and the control box a part of it. The starting contacts, operated by the trolley wheels, are

SEMAPHORE STREET CAR SIGNALS *at crossing in Cleveland, O. Starter's box at left. Note carefully red signals on near sides of crossings for stop signs, green signals on far sides for safety signs. Both cannot show at once. Lights by night and discs by day.*

placed about eight poles from the highway in each direction on the corresponding track, and the stopping contact is at the highway, there being four contacts in all. Flashing pilot lights are located three poles ahead of each contact to indicate the bell operation to the motorman. The control circuit, bell and lights are all tapped from the trolley, and no other source of power is used. The speed reaches a maximum of about thirty miles per hour under the contacts, the bell ringing twenty to twenty-five seconds before the car reaches the crossing. The warning indication is given by a 12-inch bell and a transparency flashing the word "Danger," one of the series of lights in this transparency being run each way to the indicator.

As the car passes the starting contact and is approaching the crossing, the action of the bell is shown to the motorman by the flashing light in the indicator. The use of a flashing light as a return indication of the actual ringing of the bell has been favorably received by the railways, as it overcomes an objection to crossing signals that the motorman must proceed assuming the bell is ringing.

There are six 23-watt 110-volt mazda lamps, shunted by resistances, so that the failure of one lamp does not affect the operation of the remainder. The flashing of the lights is produced by a contact maker on the armature of the bell clapper. On account of cars following closely over the crossing, a type of bell was chosen having a car-counting control such that the bell will not be cut out at the stopping contact until all the cars that have passed the starting contact have also passed the stopping contact.

The sign consists of a neat cast iron danger transparency with red lights within, accessible by opening latched doors at the side, the letters in the transparency being six inches high. The words "Railroad Crossing" in raised letters are arranged in a circle around it. The bell and relay unit hang on the pole below, the hammer striking the bell thru an opening from within, making a weatherproof construction. The relay unit comprises a pair of counting magnets, operating a revolving switch in the manner of a drum controller, and the bell magnet, which breaks its own circuit. The contacts are oil break, the oil tank covering the entire relay.

Below the bell, about the height of a man, is the fuse and control box, from which all bell circuits may be tested out, disconnected or fused, and the bell started and stopped manually. The wires enter the standard in a cable suspended from a messenger wire as is usual on

CROSSING SIGNAL *at Hume, Va., operated by cars on either track. The word "Danger" is lighted and the bell is rung by car approaching on its proper track.*

switch indicators. The entire standard is mounted on a concrete pedestal by foundation bolts.

There is a similar signal at the double-track crossing at Hume, on the Alexandria division. There is a good view of the tracks both ways from the highway, which crosses at 45 degrees. This is an important and busy thorofare. Cars pass every 20 minutes during the day and every 10 minutes during rush hours morning and evening. Cars are run singly and with trailers having no trolley.

At Military road, near Rosslyn, Va., on the Falls Church division, there is a single-track crossing signal installed on a main highway leading to Fort Myers, where maneuvers are held, and funerals and tourists' sight-seeing cars pass frequently. Trolley cars follow each other closely at certain times of the day, passing every quarter hour. The starting contacts in this installation are about nine spans away from the highway, three contacts being used. The control of this type of bell is both car-counting and directional.

The frequency of cars at this point amounts to the bell ringing about one hour in the twenty-four hours. The bell and relay unit with bracket is mounted on an existing pole and a separate danger transparency is hung by a bracket on the same pole. This is somewhat novel and consists of a sheet-iron sign with letters twelve inches high, composed of small lens-like glasses, with many facets, the letters themselves being white on a black background. The subdivision of the glass into a multiplicity of small units is a protection against malicious breakage, and, like the military mast on warships, would require many blows to demolish it.

The photograph above shows the crossing at Hume with the door of the control box open, while in that below the environments of the crossing may be seen. To the right and above the signal the trolley contact may be seen. This has no moving parts.

VIEW OF ROAD *at the Hume crossing shown above. The signal is visible for a considerable distance in either direction, and the road makes a sharp angle with the tracks.*

SEWAGE DISPOSAL WITHOUT ODOR

By Rudolph Hering, Consulting Engineer, New York City.

This article is that part of a paper before the American Association for the Advancement of Science at its Philadelphia meeting, which is devoted particularly to the methods for treating the collected sewage and rendering it innocuous, and considers them specially with reference to making the processes inodorous, at least to the extent that they shall not become offensive to surrounding inhabitants of the district. The author is fitted to speak with authority, having done as much as any one to introduce inodorous methods of sewage disposal.

ALL processes of sewage treatment and disposal, if they are to be satisfactory, permanent and economical, should require a separation from each other of the floating matter, of the settling matter and of the liquids.

As these three parts of the sewage are materially different substances, one being solid and light, one solid and heavy and one liquid, the methods of economical treatment in order to make them inoffensive will also be different in nearly every case, and therefore a separation is generally to be recommended. It is not always made, and at some places it may not yet be of sufficient importance to justify the additional expenditure. The drift of opinion, however, is clearly in the direction of separation and we should endeavor to design our works accordingly.

The floating matter can be retained with little trouble and expense, either by screens or as scum in settling tanks. Being often offensive, the best disposition is usually by fire or by burial. Numerous screen designs are now in use, but there is practically no preference so far as the prevention of odors is concerned.

The settling matter which forms the so-called sludge is that part of the sewage which has always given the greatest amount of trouble, has constituted the greatest nuisance, and until very recently has successfully defied a treatment which would make disposal inoffensive.

The bulk of the sludge does not decompose by oxidation. Its exposure to the air allows but a thin film to oxidize at the surface, but the exposure permits it to take up many species of bacteria, some of which cause offensive putrefaction. Many ways and means have been tried for the last fifty years, both in England and Germany, to get inoffensive sludge decomposition. A solution has at last been found in an expedient which allows the sludge to decompose under water, with the practical exclusion of fresh sewage and air.

The first step towards getting this result was taken by Dr. W. O. Travis, of Hampton, England, who devised a two-story tank, the upper division serving as a settling tank, with a slot at the lower edge of an inclined bottom, thru which the settling suspended matter passed into the lower division to accumulate and decompose. The in and outflows of the two tanks were so proportioned that from three-fifths to four-fifths of the sewage passed thru the upper division and one-fifth to two-fifths thru the lower one. So far as an inoffensive sludge decomposition is concerned, this Hampton tank is not a success.

The same two-story tank was later built in the Emscher district of Germany by

Dr. Ing. K. Imhoff, with at least one important change. No sewage whatever was allowed to pass thru the lower tank, causing a practical exclusion of any part of the sludge from a continuous contact with fresh sewage and air. Other advantageous changes were suggested.

The decomposition of the sludge takes place in the lower division of the tank in the absence of dissolved oxygen in the sludge. but the novel condition is that it continues in the absence also of sulphur bacteria producing sulphureted hydrogen, aud in the presence of bacteria producing substantially only methane and carbon dioxide gases, neither of which has an offensive odor. The conditions in the tank gradually become adjusted to conditions favoring the life of substantially only those two classes of bacteria and causing practically all of the others to perish.

¶ AN EXPERT REPORT *shows the inoffensive character of sludge treatment in absence of light. air and fresh sewage.*

The Royal Institute for Water Hygiene in Berlin, through Prof. Dr. K. Thumm and Prof. Dr. C. Reichle, has recently issued a report on the results of a thoro investigation of this new method of inoffensive sludge treatment, from which substantially the following conclusions are extracted:

The process of decomposition of sludge is found to differ sometimes quite materially according to the character of the sewage. The same arrangements and designs will, therefore, not suit all of the conditions nor all localities. The topographical conditions, especially as to available areas and elevations, make different designs a necessity for economical reasons. They will determine whether the sludge decomposing chamber should be located below (Emscher tank) or beside the settling tank. In all cases a sharp distinction must be made between a simple settling of the suspended matter and the decomposition of the sludge.

During the process of ripening the sludge of the Emscher tank has a grayish color. When ripe it is deep black, has a peculiar tar-like though not disagreeable odor, and easily allows its water to drain away in a fairly clear, colorless condition and without a putrid odor. The sludge reacts alkaline. When left too long in the sludge chamber and when it has become over-ripe, it again changes to a grayish color and has an offensive odor, it does not easily drain its water and has a distinct acid reaction. In order to decompose quickly and satisfactorily sludge should not be acid. If found to be so, it is generally due to an excessive vegetable diet. It should then be brought into intimate contact with a sufficient amount of slightly acid-neutralizing bodies, among which the most common are fresh sewage and hard water.

¶ ALKALINE SLUDGE *is essential and can be secured and maintained by several methods here clearly stated.*

The Berlin Experiment Station has pointed out the great desirability of having a proper mixture of sludge and sewage in order to secure a good alkaline sludge. It is, therefore, advised for this purpose to install a mechanical agitator in the tank, to be used daily for effecting a thoro mixture. The results of this agitation were always found to be good. The introduction at the bottom of compressed air escaping and rising thru the sludge was also found to be effective, tho less so than mechanical agitation.

It was also found essential to withdraw the decomposed sludge regularly, frequently and in small amounts. If not so withdrawn and at the proper time, it is apt to become acid and dead.

It sometimes occurs that on the surface of the tank there is an undue frothing and excessive scum formation. After due consideration and experiment it was found that these objectionable conditions could be removed by draining off the sewage in the sludge chamber and refilling the same with clean water from the municipal supply, especially if it had considerable temporary hardness. In some cases a good sludge can be produced only by the addition of slight quantities of

alkalies, as lime or soda, to the sewage.

The Berlin Experiment Station gave a careful study to the scum and frothing in the settling tank and in the chimneys connected with the sludge chamber, other important conclusions being as follows:

¶ FROTHING *and consequent overflow of the frothing material is troublesome, but can be prevented by the methods described.*

It is not advocated as a permanent measure to reduce the scum cover in thickness by merely an occasional stirring with poles or by breaking it up with a stream of water. It is preferred to use a permanent mechanical apparatus or agitator which not only stirs the scum but brings about a thoro mixture of it with the sewage, subsequently allowing the necessary time for sedimentation. Frothing is found to be due mostly to large amounts of gas rising to the surface from the sludge chamber and carrying up finely divided sludge with the bubbles. Agitation usually prevents this trouble. When the sludge in the lower chamber is ripe, the scum formation in the upper chamber is light.

When there is great activity in the decomposition, sludge particles rise thru the slot into the upper chamber in spite of the usual overlapping of one side of the slot, intended to prevent such rising. Sufficient room should be provided for accommodating the floating sludge in order to prevent operating difficulties.

¶ SLUDGE TANKS *may be placed below or alongside the sewage settling tanks, with the advantages and disadvantages here stated.*

Studies were made of the effects of the relative advantages of two groups of tanks, one having the sludge chamber below and the other beside the settling chamber.

The first group has the great advantage of an automatic sludge separation. It has the disadvantage frequently of increased expense due to the greater depth of excavation. This greater depth has in itself the advantage of placing the gases of decomposition in the lower tank under increased pressure, which causes the sludge to expand, become more porous and more readily drained when it is withdrawn and discharged on the surface of the ground. Another disadvantage of the first group is the necessity of giving a very close attention to the sludge removal, and to get the right proportion of capacity between the upper and lower chambers. Unless the proportion of sludge to the superimposed liquid approximately corresponds to the character of the sewage and sludge, the results may not be satisfactory in finally turning out economically an inoffensive sludge. Expert supervision is required, particularly during the period of ripening.

The second group has the disadvantage of pumping or of conveying the sludge from the settling to the sludge decomposing tank. It has also the disadvantage of producing less easily drainable sludge, due to the shallowness of the tanks. It has the advantage of a complete separation of the two tanks, so that the sludge decomposing tank can never thru irregularities have a detrimental influence on the settling tank. Extensions can also be more easily made to the tanks and they can be more readily inspected.

The separate sludge decomposing tanks can be built as single units which are intermittently filled, or they can be built as a series of tanks continuously operated.

¶ THE OBJECTIONS *to the dilution method of sewage disposal are often due to improper application of the process, which is, after all, the natural process.*

The City of Baltimore has installed separate sludge decomposition tanks and the experience there gained will be valuable. The City of Brookline is conducting some experiments with a similar device of using tanks beside each other and also one over the other. The decomposed sludge is found to be equally good in both cases. The preference between the two methods may usually be decided by the

relative economy and facilities for construction and operation.

Considering now the last part of the sewage to be disposed of, namely, the liquid, we find that the commonest, because cheapest, way of disposal is to turn it into running water. This process is called the dilution method.

There has been much popular objection to such a disposal, partly due to cases that have caused much offense and partly due to sentiment. Neither reason is valid against the method if it is properly applied.

Most of the objectionable organic waste matter on the surface of the earth is by nature discharged into and purified by either air or water. Our exhalations and all gaseous waste products are purified by a preliminary dilution in the air. All the rain water flowing over the surface of the earth, the accumulated wastes of animal and vegetable life, are washed into rivers and then into the ocean. Some rivers purify such waste matters within a few miles of flow. Some cannot purify at all water loaded with suspended mineral matter. As soon, however, as the ocean or a large lake is reached, all objectionable waters are completely purified.

The dilution method is quite efficient for sewage disposal and is in every way satisfactory, provided we recognize the principles on which it can be carried out. There is a certain varying amount of oxygen dissolved in all running fresh and salt water, which is taken up from the overlying atmosphere in accordance with well established physical laws. On the other hand, there is a certain varying amount of oxygen required by the different parts of the organic matter of sewage which is necessary to oxidize it. Therefore, generally speaking, we have the question as to how much of this oxidizable organic matter can be decomposed by the available dissolved oxygen in the water.

A large number of chemical, biological and physical examinations have been made to determine the elements of this problem. A large number also of actual cases of sewage disposal by dilution for American and European cities have given practical demonstrations of the advantages and limits of this method of disposal. The conclusions which may now be drawn from all the evidence are quite satisfactory.

¶ THE REQUIREMENTS *of safe discharge of sewage into running water are simple and are briefly stated.*

In order to discharge sewage safely into running water so as not to create nuisance, we should first deprive it so far as practicable of all floating matter which would deface the surface of the stream, and of all heavier matter which would settle and deposit on the bed of the stream. The remaining liquids should be discharged so far below the surface as practicable and dispersed into and distributed thru a body of flowing water which is great enough to contain the necessary oxygen required to oxidize the organic matter coming in contact with it. A sufficient dilution causes an immediate cessation of all nuisance, if one existed, or prevents its occurrence, if the above simple conditions are maintained. By following such a practice no offense to sight or smell can ever arise.

Another method of oxidizing the liquid sewage is to expose it in such a way that atmospheric oxygen will cause the oxidation of the dissolved organic matter. This is done by the well-known methods of so-called filtration.

The liquids are made to pass through a bed of sand or broken stone, so that the surfaces of the grains become wetted by the percolating sewage. The surfaces in a ripe filter are covered with a gelatinous film, supporting myriads of bacteria which decompose the dissolved organic matter contained in the liquid percolating thru the film. The decomposition takes place in the presence at the film of a sufficient quantity of oxygen containing air and of a suitable temperature for the best bacterial activity. There is a definite relation between these factors, and it will be possible, eventually, to arrange them so that the greatest bacterial activity can be determined at the least cost for each given case. This branch of the

science of sewage purification yet needs some further development to determine in all cases the best proportions.

¶ THE PRINCIPLES *of action of various filtering materials differ and the methods used must conform to these principles.*

If sand is used, the liquids may be turned upon the top of the filter bed, from which they will percolate and wet the surfaces of all the grains and issue in an oxidized condition at the bottom drains. If broken stone is used, the liquids must be sprinkled over the surface of the beds or left in contact with the entire body for a sufficiently long time, generally by repeated applications, to get the same effect.

The recent advances made in oxidizing liquid sewage have not been great. A large field is still open for investigation, in order to obtain the greatest possible efficiency with the least cost under the usually variable conditions of practice.

Having now, as regards sewage disposal, covered the subject of nuisance, it remains, in closing, to mention the removal of dangers to health relating to such disposal. These dangers lie in the transportation to other points of pathogenic bacteria contained in the fresh sewage from sick persons and in the subsequent possibility of their once more getting into the bodies of human beings and higher animals.

Bacteria not only adhere to particles of solid matter, but remain in any liquid carrying them. It is possible that solid particles of sewage may be stranded in sewers, be held back and finally be blown away by an air current, enter the atmosphere and thus, by contact, cause a new infection. It is also possible that liquids may splash and throw bacteria into the air. In both cases the danger of transmitting disease is extremely small, if the sewers have smooth interior surfaces, no opportunities for eddies to form, and good grades to cause a rapid velocity from the sewage receptacles to the outfall, conditions which have been advocated for many years.

¶ HOW TO PREVENT *the dissemination of dangerous bacteria before they are destroyed by the purification processes used is an important problem.*

If the sewage is discharged into a sufficiently large diluting current of water, the pathogenic bacteria are gradually starved and perish. If the sewage is treated on land, there is some slight risk of transfer by violent winds. Generally the bacteria are either retained in and carried away by effluent water or are held back on the grains of the filter. In the latter case they eventually perish by exposure in the unfavorable environment, and in the former they can be at once destroyed by an inexpensive chlorine treatment such as is now for the same purpose given to most of our surface water supplies.

From what has been said above I believe that we have at last reached a stage of development in this branch of sanitary engineering, which enables us efficiently and economically to collect sewage at its sources, carry it to the outfalls and there dispose of it either in water or on land without causing offense at any point along its course and reduce to a minimum all danger to health.

A NEW BUILDING MATERIAL

Since natural clays first were used as building materials many thousands of years ago there have been few, if any, fundamental changes in the processes of manufacture. The first building brick was probably molded by hand and baked by the heat of the sun. Later artificial heat was employed to hasten the process of hardening. With the introduction of power driven machinery the process of molding was improved. Experience has pointed the way to superior methods of mixing and preparing the clay for manufacture. But the basic principle upon which brick and clay products are manufactured is essentially the same as that which governed the industry in its earliest stages.

This article describes a new process of making brick. The process involves a simple chemical combination of materials and the resulting product is stronger and more durable even than granite. It is fire proof, frost proof and sanitary. A factory for the manufacture of it is now under construction. The introduction of this process gives promise of marking the beginning of a new era in building construction.

THE industry of making ceramic products or of molding clay or other earthy materials into desired shapes and hardening it by the application of heat was one of the earliest arts engaged in by man. It has been impossible to fix the date at which the use of such materials began. Pottery and building materials of clay composition are found in excavations revealing the earliest stages of civilization. The art was known to all races of people and on all continents of the earth.

Fundamentally the processes of manufacturing brick and ceramic products as practiced to-day have not been materially improved since their introduction. Improvements have, of course, been made in methods of mixing, molding and handling, and advantage has been taken of improved methods of developing power and heat, but the processes of manufacture still involve the selection of natural clay which possesses the property of hardening under the action of heat. The finished product of to-day is perhaps not superior to that of the ancients, and, in some respects, it may even be regarded as inferior. The present-day product undoubtedly does not possess the durability of the ancient product and does not always show the same degree of care and skill employed in manufacture. The brickmaking industry, as conducted under modern conditions, is somewhat stereotyped. A deposit of so-called "brick" clay is located and an empirical formula is developed, according to which the clay is mixed, molded and fired. While deposits of brick clay have been found in many localities, there are many sections of the country which do not possess them, the result being that the cost of good brick in such sections is extremely high, due largely to the expense of transportation. Altogether it may be said that the brick-

PILE OF TAILINGS *from a coal mine located on the property of the American Brick Company at Lincoln, Ill. End view.*

making industry has failed to progress in a degree comparable to the strides which have been made in other lines.

It is, therefore, a matter of unusual interest and importance to record the development of an entirely new process of making brick; one which is not dependent upon the presence of so-called natural brick clays; and one which may be employed in all parts of the country, and one which offers the most attractive commercial possibilities. Such a process of brick-making has been invented by Mr. A. Malinovszky, a ceramic chemist of long experience in the manufacture of refractory materials. The process has been perfected to a point of commercial practicability after long years of experimenting and has been protected by patents in the United States and foreign countries. A plant to manufacture brick according to the new process is now being constructed at Lincoln, Ill., by the American Brick Company, a two-million-dollar corporation, which controls the patent rights. A number of plants are to be built in various parts of the United States, and the activities of the company will be extended to foreign countries as soon as practicable.

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¶ THE PRINCIPLES *and the process of making the new brick are simple and the results are obtained more quickly than with other materials.*

The process utilizes a simple principle of combining chemically natural materials which may be found in abundance in many localities thruout the world. By-products of many industries may also be used. Briefly, it consists of mixing any coarse material containing silica with a binder of finely divided particles of alumina, silica and potassium or sodium in proportions which vary for the different substances and which may be determined in the case of each new supply of material by chemical analyses. One of the purposes of the process is to obtain a low fusing point for the binder and a relatively high fusing point for the coarse material. The material is molded, preferably dry, under high pressure, and is fired in a manner similar to that which is employed in the manufacture of ordinary brick. The process of firing, however, requires a much shorter period than is necessary in ordinary brick manufacture. The brick can be made in an ordinary down-draft kiln in two or three days.

Since the process was perfected many thousands of brick have been made with the use of various materials. The company has also made analyses of materials obtained from practically every state in the Union and from various locations in each state, a total of 260 such analyses of deposits having been made. Many samples of the finished product have been analyzed by various consulting chemists,

testing laboratories and geologists thruout the United States, and similar analyses and tests have also been conducted in Germany.

For the purpose of this article it will be sufficient to quote from the reports of a few of the scientists who have conducted the tests. Robert W. Hunt & Co., testing engineers, made some absorption, frost and fire tests on two sample bricks. The following is quoted from their report:

Absorption Tests.

"Two bricks submitted were carefully weighed and immersed in water for a period of forty-eight hours. They were then again weighed, with results as follows:

Specimen marked	A-1	A-2
Color	White	White
Weight before immersion, lbs.	5.109	5.172
Weight after immersion, lbs.	5.250	5.258
Percentage absorption	2.75	1.66

Frost Tests.

"The two bricks, A-1 and A-2, were directly from the absorption tests placed in cold storage for a period of forty-eight continuous hours at a temperature of 0 degrees—10 degrees Fahrenheit. After removal from cold storage neither showed any apparent indications of checking or disintegration as a result of the frost action.

Fire Tests.

"One-half of the brick A-1, after submission to tests above, was dried out and placed in a gas-fired furnace.

"During a period of five hours the temperature of the brick was increased to 2900 degrees Fahrenheit and maintained there for a period of one-half hour.

"After being allowed to cool with the furnace the brick was examined. The specimen showed some vitrification, but retained its form, and apparently was otherwise unaffected by the test."

A crushing test of the brick was conducted by Professors Talbot and Abrams, of the University of Illinois. Their findings are shown in the following table:

Results of Crushing Test conducted at the University of Illinois.

Ref. No.	Color.	Weight, lbs.	Section, inches.	Length, inches.	Maximum applied load, Pounds.	Unit load, lb., per sq. in. Over	Remarks.
1	White	5.5	2.25x3.90	7.95	565,000	18,200	Loaded on sides. Cast iron bearing block broke at 565,000 lbs. Brick was apparently uninjured by this compressive load, altho it was broken at the middle as a result of the failure of the bearing block.
2	Buff	5.5	2.18x3.85	7.90	607,000	19,900	No result at maximum load.

These bricks were tested in the 600,000-lb. Riehle testing machine. The faces were nearly plane surfaces. A cushion of three layers of building paper was placed between the loaded faces of the brick and the bearing plates. A hemispherical bearing block was used.

It is interesting to note that the No. 2 sample stood a slight excess above the capacity load of the testing machine, or a unit load of 19,900 lbs. per square inch, and showed no evidence of failure. Sample No. 1 was apparently uninjured when a failure of the bearing block of the testing machine occurred under a unit load of 18,200 lbs. per square inch.

Professors Talbot and Abrams also conducted an absorption test, results of which are given in the following:

Reference number	3
Color	White
Weight, room dry	2,387

Weight, after drying 24 hours	2,387
After 24 hours in water	
Weight	2,389
Water absorbed	2
Per cent absorption	0.08
After 48 hours in water	
Weight	2,390
Water absorbed	3
Per cent. absorption	0.13

Weights are given in grams.

Absorption test was made on a whole brick, one 2-inch face of which had been polished. Before placing in water the brick was dried in a steam oven for twenty-four hours. After cooling it was placed flatwise in water to a depth of 1 inch in a covered pan. Before weighing superfluous water was removed with blotting paper. The balance used was sensitive to 1 gram.

Prof. Rollin D. Salisbury, geologist, University of Chicago, made a microscopic examination of several samples of the brick and submitted an article on the subject, the essentials of which are quoted in the following:

"In order to determine the real condition of the material within the brick a series of thin sections, eight in number, were made and examined under the microscope. These examinations showed that in all cases the baking had produced fusion enough among the materials used in the making of the brick to develop a glass (as in lavas), and that this glass serves as a binding material for the original grains which were not fused. These grains are bound together by the glass very much as the crystals of some igneous rock are bound together by the glassy (not crystallized) part of lava. In physical constitution, therefore, the brick is very like a very compact igneous rock which is but partly crystallized. The building material is adequate for strength.

"The texture of the brick is such as to indicate the possibility of a high polish, and the grain is so fine and even that clean-cut lettering and carving should be possible. The composition of the brick is such that lettering or carving should be as durable as in hard rock, and more durable than in marble.

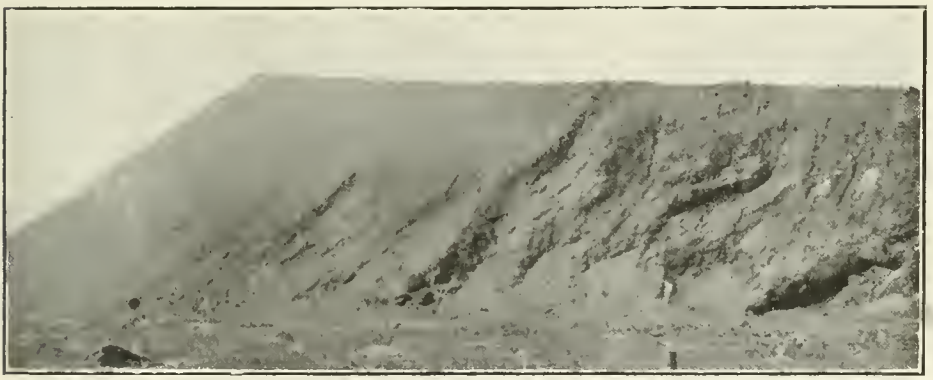
"The materials used in the manufacture of the brick are so plentiful and widespread that there should be no difficulty in finding them in abundance in many places.

"The description of five of the slides follows. The other three are omitted, as they present no features not shown in the five described:

No. 1—A medium-dark gray brick.

"Under the microscope it is seen to consist of grains of quartz, orthoclase, magnetite and an altered ferro-magnesian mineral, in a glassy ground mass. This ground mass was developed in the burning and is the result of the fusion of parts of the substance of the brick. Pore space, about 11 per cent.; but it should be noted that this is not the amount of space that will take up water, for the pores are in the glass and not accessible

SIDE VIEW *of pile of tailings from coal mine, indicating supply of brick material available at this location.*



to water. The pore space into which water can penetrate is very small.

"The grains of quartz are angular (many) or rounded (fewer), apparently as they were before burning. They show little, if any, sign of corrosion. The corners of the angular grains remain sharp, but there appears to be a very thin film of clear glass surrounding each.

"The feldspar grains, both orthoclase and plagioclase, are much altered on the outside, and grade into the ground mass without sharp demarkation. The smaller grains are altered thruout. Under the microscope the original grains are seen to be broken up into extremely fine fragments, which are bound together by isotropic material. The effect of the heat appears first to have fractured the grains and then to have fused the material along the cracks. The little particles into which the feldspars are broken average about .002 mm. in diameter. There appears to be considerable kaolin, probably such as occurred in the original material from which the brick was made.

"The ferro-magnesian mineral is so much altered that its original character is not recognizable. But little of it is present. It is now altered to magnetite, surrounded by a brownish stain. It grades into the ground mass.

"The ground mass is of glass, filled with minute (about .002 mm.) particles of quartz and feldspar.

"The union of the original particles seems to be as complete as in extrusive igneous rock which contains some glass.

No. 2—A white brick with a pink tone.

"Under the microscope this slide shows more of the glassy base, and therefore less mineral fragments, than No. 1. The constituents are quartz, an altered ferro-magnesian mineral (rare), some magnetite, hematite, and much altered feldspar (?). Pore space, about 10 per cent. As in the preceding case, the pore space which water could enter is very small.

"The quartz appears in both rounded and angular grains, the former much more numerous than in No. 1. There seems to be a little more fusion effect in the quartz grains than in No. 1, for while the edges of the grains are not embayed by corrosion, there seems to be a thin film of glass around each grain, but this is not in all cases distinct.

"The feldspars are much more altered than in No. 1. The outlines of the original grains may be seen, but they are broken up into small granular aggregates, as in No. 1.

"There are little patches of magnetite and hematite, apparently indications of the former presence of a ferro-magnesian mineral. The original, however, is entirely altered. The ground mass is glass, as in No. 1.

No. 4—Nearly white brick, with very few black spots. Whiter than No. 2.

"Under the microscope very similar to No. 2, so far as shapes of grains and proportions of ground mass are concerned. The angles of most of the angular quartz grains are sharp, but in some cases there is clearly a reaction rim with the glass of the ground mass. The other principal mineral used, probably feldspar, is in most cases altered completely and mingled with the ground mass. Even the original crystal boundaries have in most cases disappeared. There is a little recognizable plagioclase. An original ferro-magnesian mineral is represented now by a stain of yellow and by aggregates of magnetite and hematite.

"The ground mass which binds the original constituents is glassy, but it shows the beginnings of recrystallization, for the glass is penetrated by numerous fine needle crystals, noticeable only with high powers of the microscope. This is a characteristic seen not rarely in solidified lavas.

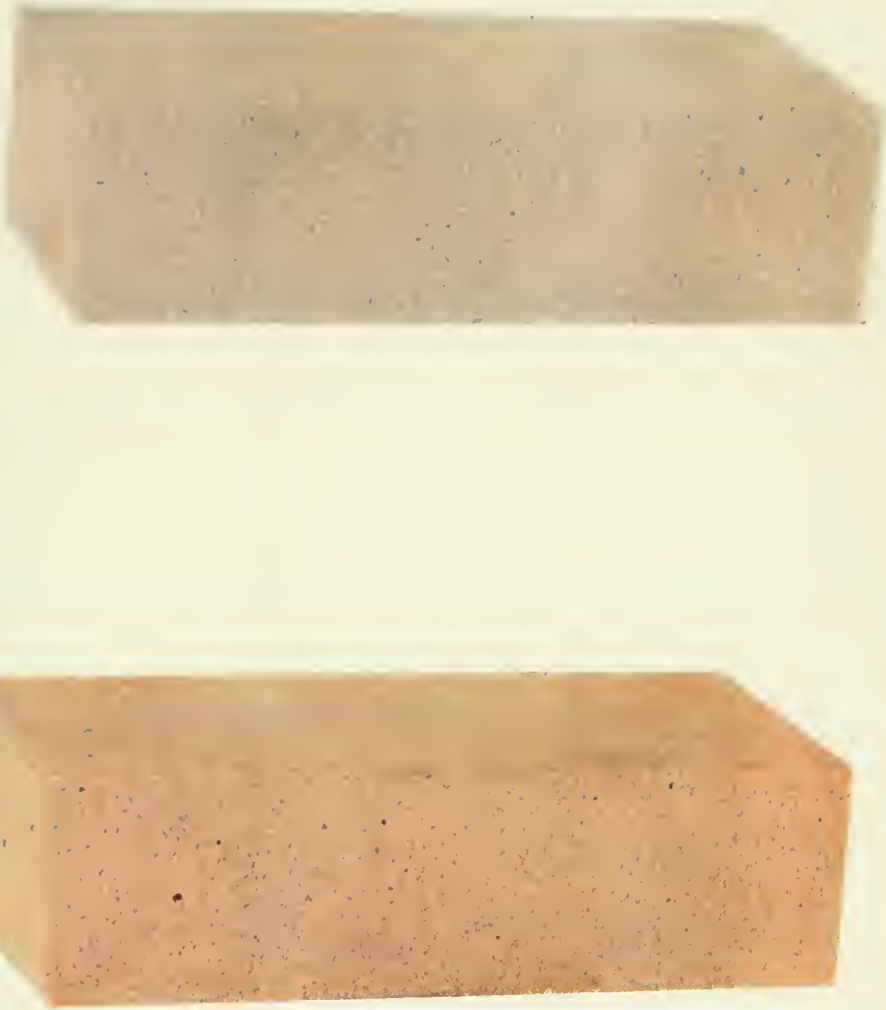
"Pore space about the same as in No. 2.

No. 5—A mottled, fine-grained, red-white-black-gray brick.

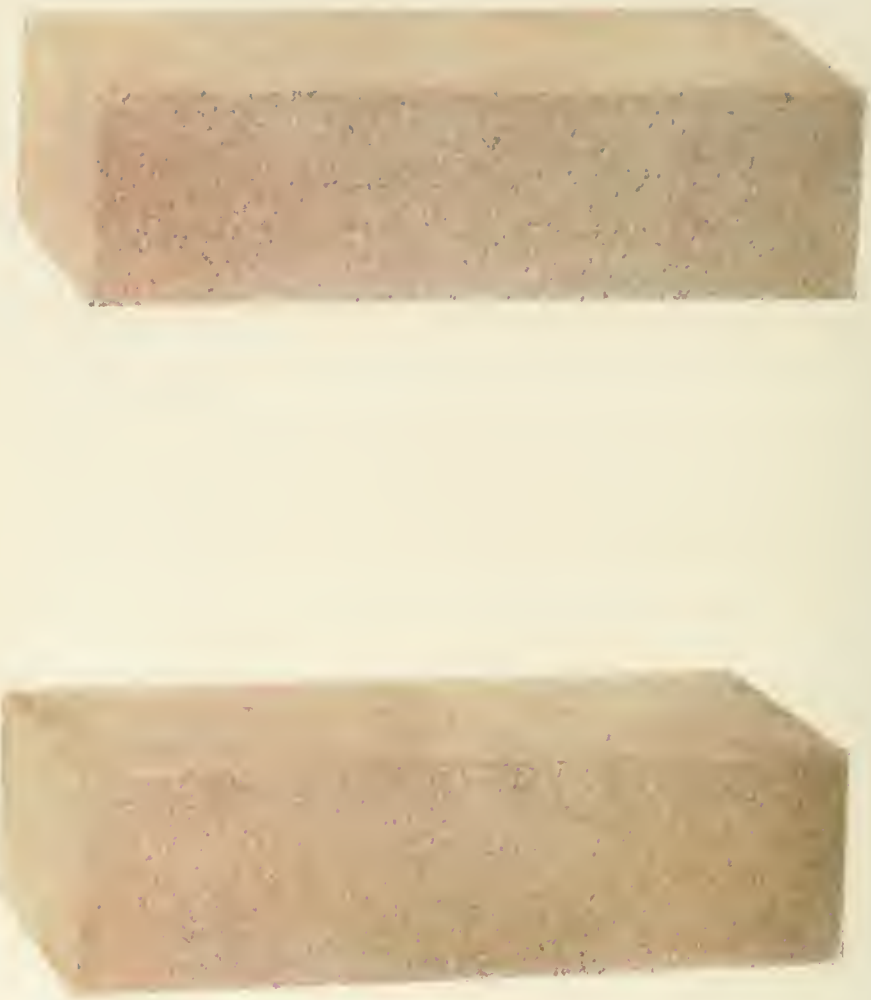
"Under the microscope it shows somewhat coarser material than in No. 1 and a smaller proportion of quartz.

"Angular quartz grains show alteration rims of glassy material. Sharp edges are slightly rounded.

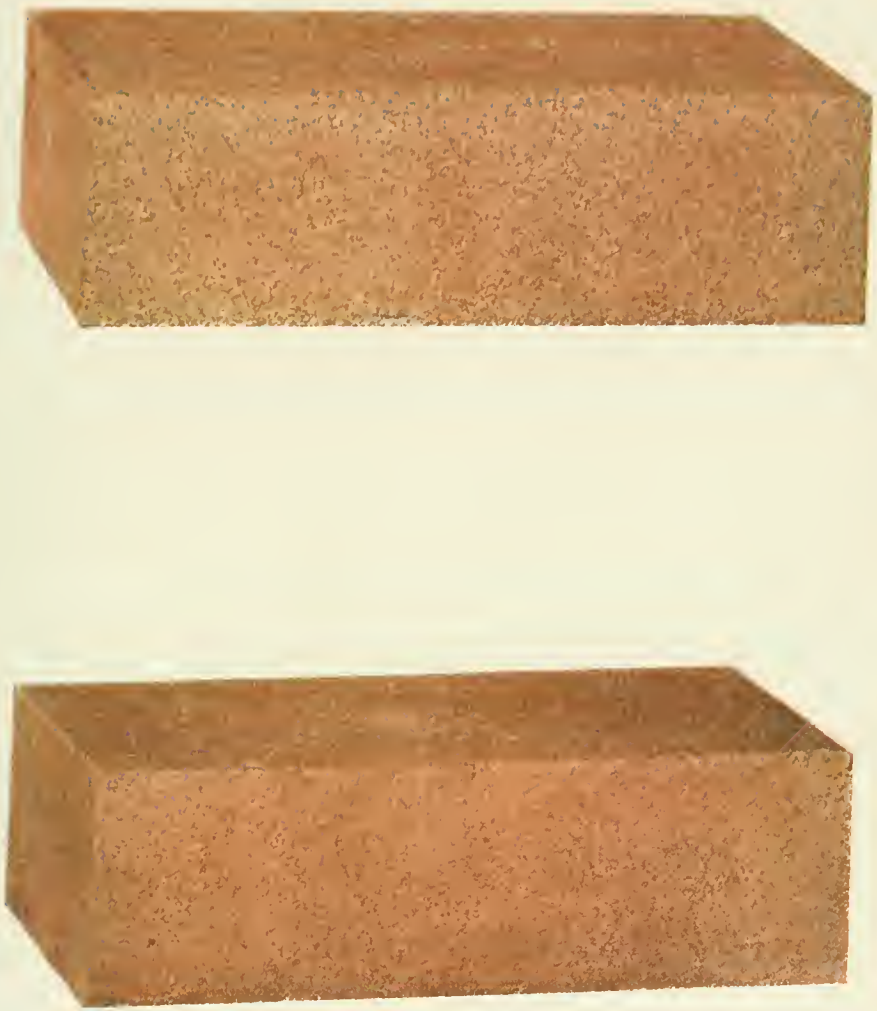
"Ground mass feldspar (?), granulated as in No. 1, but also shows recrystallization, with fine needles, as in No. 4. This recrystallization is much better developed in some grains than in others, suggesting



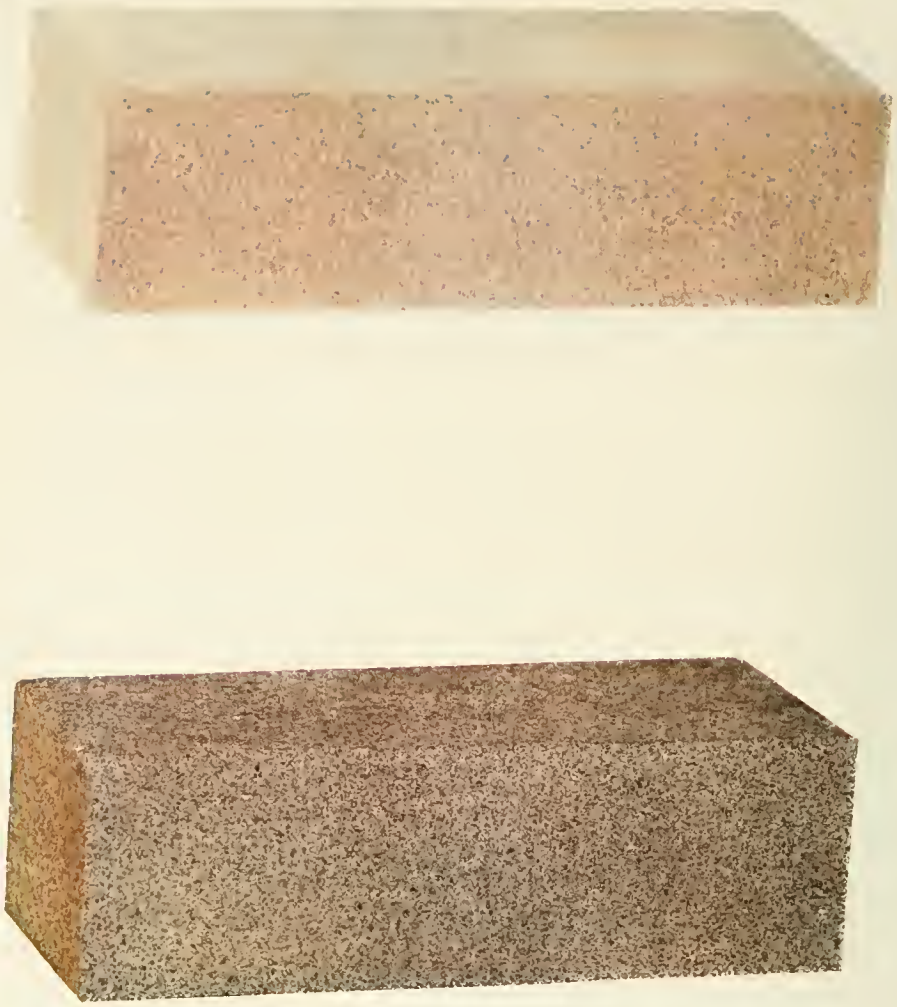
FACE BRICK, not polished, shown in true colors.



POLISHED FACE BRICK, shown in true colors. The structure is fine and the appearance more beautiful than French Granite.



ROSE TINT FACE BRICK, not polished, shown in true colors.



POLISHED FACE BRICK shown in true colors. The colors are as delicate and soft as those of an oriental rug.

that two kinds of feldspar may have been present. Some of the grains appear now only as a mass of glassy material shot thru with a felt of fine secondary needles.

"Iron oxide is much more abundant than in any of the preceding. It appears in the form of a yellow stain, as hematite and as magnetite. Kaolinization present in the feldspars, but this may represent the condition of the original material.

"The ground mass is clear glass, or glass full of grains and needles.

No. 8—A yellowish brown, fine granular brick.

"Under the microscope, similar to No. 1 in size of grain and in the relative proportions of ground mass, and included mineral fragments, but it contains more iron oxide.

"Quartz grains are rounded and angular. The angles are sharp, showing very little reaction due to heat. Granulation of the feldspar as in No. 1, but the outlines of the original grains are clearly recognizable. Not so much altered in the baking as Nos. 4 and 5; occasional plagioclase grains, hardly altered. Most of them, however, are broken up and grade into the ground mass as in the previous cases. There is much iron oxide occurring as a brown stain, and as grains of hematite and magnetite, scattered uniformly thruout the mass. There is greenish stain of chlorite, derived from some original ferro-magnesian mineral."

Prof. Dr. H. Seger and C. Cramer, chemists and chemical engineers, of Berlin, Germany, made an elaborate analysis and examination of samples of the brick. The essential facts brought out by their report are given in the following quotation:

"We received a sample of brick of a grayish white color with dark spots, and also a brownish sample.

"Results of the analysis were as follows:

"In determining the poronsness it was found that the lighter sample of brick absorbed 2.8 v.H. (per cent.) of its dry weight of water, and the brownish sample 5.1 v.H.

"To determine the compressive strength we sawed cubes, 5.5 cm. long on the edge, from the samples, and analyzed these in the usual manner to determine the compressive strength, with the following results:

Lighter Sample.	*Darker Sample.*
1500 kg. per sq. cm.	928 kg. per sq. cm.
1392 kg. per sq. cm.	782 kg. per sq. cm.
Average—	
1446 kg. per sq. cm.	855 kg. per sq. cm.

"We then analyzed the samples for the purpose of determining their resistance to frost. This test proved that the brick does not scale.

"In the pyrometric determinations, which were made by comparison with Segerkegeln, the lighter sample began to melt with Segerkegel 13 and the darker sample with Segerkegel 13 to 14.

"The preceding determinations yield the following facts:

CLOSE VIEW *of material from which the American Brick Company will manufacture their product in their Lincoln, Ill., plant.*

"If the bricks sent to us may be considered as representative samples, the brick consists apparently of ground natural stone which has only a slight porousness and a high compressive strength; this is especially true of the lighter sample. The samples may be designated as impervious to frost. Their melting point is approximately the same as that of granite.

"The samples analyzed may be utilized for hydraulic structures, foundations, and for street and sidewalk paving."

It is interesting to note, in connection with the statement made in the Berlin report quoted to the effect that the melting point was found to be approximately the same as that of granite, that European granite or German granite possesses much higher refractory qualities than American granite. It is also of finer texture.

It is proposed in the Lincoln, Ill., plant now under construction to manufacture the new product from the tailings of coal mines, the material not being suited to any other purpose because of the high percentage of lime, sulphur and iron contained in it. The process, however, is such as to enable the use of this material with entirely satisfactory results. The presence of iron in a finely divided chemically combined state produces in the surface of the finished brick splashes of dark tan, which, on a background of light tan, give a most attractive and unusual appearance to the product.

Photographs of the material ready for use in the first plant are presented herewith. It contains approximately 200,000 tons of usable raw material.

The brick takes a very high polish, and when polished presents an appearance very similar to that of granite. It is, however, of closer grain than granite, a characteristic which will probably enable it to retain its polish for a longer period than granite. Photographs of several samples of the brick, reproduced in true colors, are presented herewith.

Mr. A. Malinovszky, who has worked out and perfected the process, was born in Austria in 1875. He comes from a family of ceramic specialists. His early life was spent at work in his father's pottery factory. He came to America in 1903, and since that date has done a considerable amount of special work in pottery factories, in the Edison plants at Orange, N. J., and in the plants of the General Electric Company, at Schenectady, N. Y., in the latter of which he was engaged in the insulating department.

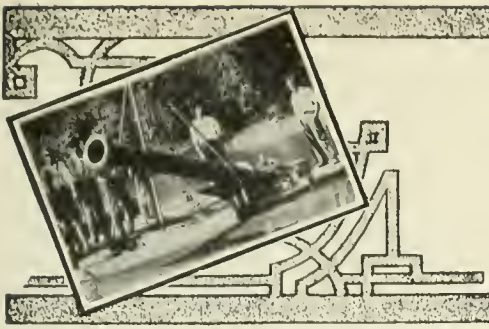
The president and active head of the American Brick Company is Mr. H. H. Randolph, a young man of broad business experience and unusual energy and capacity. He was formerly engaged in the investment banking business in the city of Chicago, and gave up a well-developed and profitable business to devote his entire attention to the interests of the American Brick Company.

The engineering work in connection with the development of the plans for the machinery and the plant layout has been done under the direction of Mr. J. E. Boynton, formerly with the Arnold Company, Chicago.

The American Brick Company is a Delaware corporation, having a total capital stock of two million dollars. Subsidiary companies have already been organized in several of the states to handle local territory.

Carefully prepared estimates have been made of the cost of producing the new product. These indicate that it will be possible to place it on the market in competition with any of the high-grade face brick now available.

A detailed study of the process and of all facts bearing upon the commercial aspect of the problem makes it evident that this new product will take a most important place in the field of building materials, and that its introduction will result in the development of many new types of construction which are not now possible with building materials in common use. The new product can be made in any desired shape and of practically any size. The American Brick Company has already developed plans for new types of construction, and these possess so many attractive features as to recommend them at once to structural engineers and architects.



EDITORIAL

THE NEW SIZE OF MUNICIPAL ENGINEERING.

For twenty-five years MUNICIPAL ENGINEERING has been published in magazine form with a printed page approximately 5 inches by 8 inches. In recent years there has been a commendable tendency on the part of publishers to standardize the size of publications. In the technical and trade field a size of 9 inches by 12 inches with a printed page 7 inches by 10 inches has become standard. The next issue of MUNICIPAL ENGINEERING will be of this standard size.

Before deciding to make the change the opinions of many readers of the publication were secured. These were overwhelmingly in favor of the new size although a considerable number felt that the present smaller size possessed some advantages and conveniences which the larger size did not have. The change has been decided upon in order to meet the wishes of the majority of the readers.

MUNICIPAL ENGINEERING will also have a new cover design for the new size. It was the first publication in the engineering field to use the full page half tone cover which is now used by a number of publications. The new cover design will be as unusual, distinctive and attractive as the old design was when first used about three years since.

CHEAP STREET TRANSPORTATION

The jitney bus, the operation of which is analyzed on another page, has frightened street railways in the cities where it is making inroads on their daily receipts, and Cleveland newspapers seem to be frightened in advance at the prospect of interference with the income from 3-cent fares, in which case fares will increase automatically when the reserve fund reaches its lower limit.

In general it is probable that these fears are not well grounded, tho there may be a few cities under special conditions, such as Los Angeles, at almost any time, San Francisco and San Diego during their expositions, and others in which street car service is poor or not sufficiently extended in which the service will be permanent.

The first jitneys were started in consequence of a strike, when their success was certain. Unemployment of some automobile owners and the congestion in street railway traffic at certain times of day induced taking up an occupation which had success behind it. The success of one led others to enter and the consequence is a flood of the new transportation facilities.

There are plenty of computations to demonstrate that the business cannot support itself continuously, except, possibly, with very cheap, second-hand machines on routes not crowded with busses, where the last wear is gotten out of the machine and it is worn out by the time it is paid for.

Plenty of work will draw off most of the present owning operators of jitneys. The wearing out of the machines will stop the lines started by automobile garage owners and over-crowding of routes will discourage others. The better times toward which we are now evidently traveling will, in short, cut the business down to a minimum.

It is probable, however, that there will be a certain amount of the business in some cities during the rush hours of mornings and evenings so long as there are autos not otherwise engaged at those hours, whether owned by private parties or by garages or taxicab companies. The street railways may therefore expect a reduction in the over-crowding at the rush hours, which will be welcome to their patrons, so that what is the loss of one is the gain of the other. The effect upon street railways charging less than a five-cent fare will be much less appreciable, and Cleveland's 3-cent fare will probably make the jitney bus competition practically negligible. The average ticket buyer on a street railway will think some time before he will regularly pay five cents for what he has been accustomed to get for three or four.

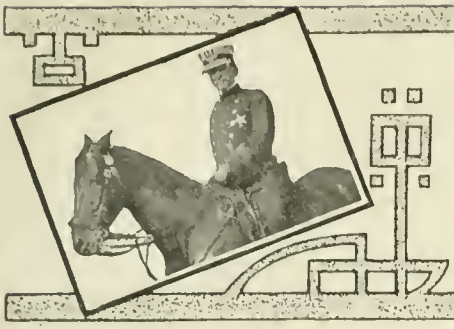
CITY MANAGERS

The communication on city managers in the west in the department "From Workers in the Field," shows that charter-making without careful study and advice from experts is likely to bring the city-manager plan into disrepute even in the homes of its friends. It is necessary to mention but one subject to show how personal preference by those influential in preparing the city charters have fixed provisions with little real knowledge of the effect those provisions may have.

The method of discharge of the city manager is one of the points upon which there is the most difference of opinion. It seems to be difficult for the average charter maker to see that he cannot have the independence of action which goes with responsibility at the same time that he keeps the control of action directly in the hands of the voters. He does not see that he cannot get a really competent and honest man for an office from which he may be removed at any moment on account of the caprice of a man, a board, or an electorate. Practically all of us are so thoroly imbued with the idea that politics is rotten and that it cannot be kept out of municipal affairs, that we are not willing to try the experiment. The consequence is that we have certain peculiar provisions contained in the charters noted in the communication referred to.

If we will follow the principles which have demonstrated their success as carefully as we are trying to get away from those we feel are failures, we will soon begin to see some improvement.

The cities having the commission form of government are trying to follow one of these principles, that of nonpartisan nominations and elections; the city of Dayton is trying to follow another, the merit system, tho a real merit system can not be fully in force until there is sufficient demand for skilled municipal employes to warrant men in preparing themselves for such positions; the state of Ohio and some of the western states are trying the third principle, that of home rule, tho the Ohio plan may be overturned in part at least by the legislature at any time. Home rule will not be safe until it is impossible for a man, who cannot do what he wishes with the city government, to go to the legislature and procure a change of the city charter which will give him the authority he wants in spite of the desires of the people of the city.



QUESTION DEPARTMENT

Franchise for Electric Light and Power Service

Our town has been approached by one of the hydraulic power companies for a franchise with a thirty-year contract for light and power, with specified rates. We have had an unpleasant experience with an oil engine which is being discarded for a steam plant, and which will be ready in two or three months. Our steam plant will have a 150-h.p. engine with two 125-h.p. boilers.

We wish to obtain information as to the rate for light and power, the cost of operation and all the statistics necessary for arriving at average and reasonable rates and a fair contract for towns and citizens situated as we are.

If such information has been published in recent numbers of MUNICIPAL ENGINEERING, please refer me to it.

S., ———, Tenn.

In the February number of MUNICIPAL ENGINEERING, vol. xlviii, p. 89, will be found an abstract of a franchise for electric light and power and water service which is in most respects modern and provides for modifications of rates at intervals in case this is desirable. Rates for electric current and electric service have changed so much in the last thirty years and the developments in electric lighting are now so rapid that no contract fixing rates for thirty years, or even for ten years, should be made by a city.

In this number of MUNICIPAL ENGINEERING will be found another article giving a method of paying for street lighting which is very attractive because at the same time it provides for any improvements in fixtures which the city is willing to pay for and removes any uncertainties as to relation of service to payment for it, which should be of benefit to both parties, but probably of most benefit to the city because ordinarily the company knows much better what it is doing in making a contract than do the city officials.

Such a contract as that considered should be worked out with the advice of engineers experienced both in electrical engineering and in franchise construction. They may be able to save the city and the private consumers many times the amount of their fees, and will do so unless the company is much more public spirited than corporations are wont to be.

This is particularly true since it is proposed to abandon a municipal plant now about ready to run. It is quite probable that a large hydraulic plant can furnish electric current at a lower rate than a small steam plant, and in that case it is good business to purchase the current of the company. Again, it may be better for the city to purchase current and distribute it to its citizens, or it may be better to contract with the company to distribute as well as supply the current. These are questions on which the advice of the expert electrical engineer should be sought.

Bituminous Streets Damaged by Street Flushing

Can you advise us of any tests made of the actual extent of damage done to pavements of a bituminous composition by water used in flushing the streets? The general opinion seems to be held that water, especially water under pressure, is damaging to the pavements; but just to what extent we have been unable to learn. Any facts you may be able to give us in this matter will be greatly appreciated.

N., ———, Cal.

A paper on "Street Cleaning Methods and Results," in MUNICIPAL ENGINEERING for September, 1914, vol. xlvii, p. 176, gives satisfactory and unsatisfactory methods of street flushing, showing that good methods produce good results.

Satisfactory machinery for flushing streets is described in articles in vol. xliv, pp. 57, 160, 284, 439; vol. xliii, pp. 118, 344.

An article on "Cost and Efficiency of Street Cleaning Methods," vol. xl, p. 32, gives figures of cost for various methods, including flushing, and references to earlier articles giving further figures. Another list of earlier articles will be found on p. 427.

Articles opposing the practice of flushing for cleaning streets will be found in vol. xl, pp. 131 and 132, and vol. xxxix, p. 316.

The writer's observation is that machines with flushing streams properly distributed and directed and using pressures not too high are no more destructive to pavements than are dry or sprinkled broom sweepers, but that hose flushing as ordinarily practiced and badly designed nozzles for flushing machines may be very destructive.

Can our readers give any comparative figures regarding flushing as compared with other methods of street cleaning as to effects on pavements?

Ordinance Creating City Forester

We have a request from an Indiana city for an ordinance creating the office of city forester. We do not know whether in Indiana the municipality has power over its trees under charter authority, or by virtue of a state law, and we therefore would like to have you refer us to an Indiana city that already has one in effect.

T., ———, Chicago, Ill.

The city of Indianapolis has a city forester provided for under its park law, which does not require an ordinance to put it into effect. The provisions of the New Jersey act of 1893, with its amendments, is an excellent basis for an ordinance governing a city forester, tho it provides for a commission with a forester acting under it. Can our readers send copies of such ordinances now in operation?

Specifications for Automobile Fire Apparatus

We have a small city which covers a large amount of territory, considerable of it beyond our water mains. Our water mains are old and very frequently we have leaks after we have been compelled to put on extra pressure during a fire. We have paved streets leading in nearly every direction towards the limits of the city, but most of our streets are sandy.

Can you give any information about what we ought to require in the way of a motor-driven hose cart, and also the cost of same?

Can you also give me any information about what advantage it would be to the city to have a pump as part of the apparatus, considering the condition of our mains and also our streets?

Our central fire station is in the center of the city. Pressure at the pump house normally is about 45 pounds higher than pressure at the central fire station, on account of difference of elevation. During fires the average pressure at the fire station is 60 to 65 pounds, occasionally going as high as 75 to 80 pounds in bad fires.

H., ———, Minn.

Real answers to these questions could only be given after a careful personal examination of the local conditions. It is evident that the water distribution system needs improvement and extension. Within the area covered by the water pipes a combination of pump and hose would be very valuable on the motor, as it might not be necessary to overstrain the water pipes by putting on full fire pressure. Outside this area the pump would be of use in reaching houses now nearly or quite out of reach with the pressure in the mains.

Pending the improvements in the water system the combination machine would, therefore, seem to one not familiar with the locality to be very desirable.

Can any of our readers send specifications for the class of machine they have purchased for use under similar conditions? Specifications throwing the competition open to all makers of satisfactory machines are, of course, preferred.

What Is El Oso Asphalt

Will you please inform me as to the nature of paving asphalt called "El Oso"? I would like to know its origin and any other information about it. SUBSCRIBER.

This is a name given to an asphalt for for paving purposes which has been used at lettings in several different places and seems to be given to a California asphalt. Will any of our readers give information about it? The writer has a sample of bituminous macadam pavement from Wellington, Kan., which is called "El Oso Pavement."

Strains in Pavements

The writer is informed that you published in one of your issues last spring some information about tests of vibration of pavements conducted by the Bureau of Public Roads.

G., Consulting Engineer, New York.

"Temperature Strains in Brick Pavements," by James E. Howard, engineer-physicist, U. S. Bureau of Standards, Washington, D. C., is possibly the article referred to, as the experiments described in it had the co-operation of the Office of Public Roads. This article appeared in vol. xliii, p. 381, December, 1912.

Dust Laying on Streets and Roads

I would like a report on water-bound macadam and the laying of dust and the best means of doing it on street pavements that require something besides water.

A book by Prevost Hubbard on "Dust Preventives and Road Binders" ($3) gives full information on all classes of dust preventives. Probably the class of temporary binders is the one referred to in the question. This includes water, sea water, calcium chloride, sodium silicate, tar, vegetable, animal and mineral oils, particularly semi-asphaltic oils, glutrin or prepared waste sulphite liquor, and other waste products, such as molasses residues. The book gives full descrip-

tions of all these materials, specifications for their quality and use, and methods of applying them.

The U. S. Office of Public Roads, Washington, D. C., has issued several progress reports of experiments in dust prevention and road preservation, which give the practical results of the use of several materials used for such purposes.

Information on Regulation of Street Traffic

I would like to have numbers of MUNICIPAL ENGINEERING containing articles regarding street traffic and its regulation.

C. H. P., Philadelphia, Pa.

Following are the most recent articles on this subject:

In vol. xlvii: "Ordinances Providing for Vehicle Licenses," p. 124.

In vol. xlvi: "Ordinances Governing Street Traffic," p. 117, also vol. xliii, pp. 38 and 388; "Congestion of Traffic on Fifth Avenue, New York," p. 433; "Regulating Standing of Vehicles in the Street," p. 123.

Berkeley Park Bathing Beach, Denver, Colo.

The Berkeley Park bathing beach in Denver, Colo., is one of the more recent developments of this sort in the city, and is not yet fully worked out, but the natural beauty of the location, as evident from the photograph, and public favor and demand will soon produce the necessary improvements. The bath house is thoroly modern, with eight shower baths and constant supply of hot water. The women's dressing rooms have four showers, a sun bath, twenty dressing booths and 150 lockers. The bath house and beach are operated by a concessionaire, who pays the city $1,000 a year for all the park concessions. Suits were provided last year for 600, but on Saturday and Sunday afternoons as many as 1,500 have enjoyed the bathing, many supplying their own suits.

The supervisors of the Denver playgrounds encourage playground leaders to use the pools for their groups of boys and the Berkeley playground leaders offer swimming lessons each day in the season, from 11 to 12 for little girls, from 2 to 3 for small boys and from 6 to 7 for older boys, all under the care of life guards and with all possible precautions against accident. A life-saving class is also conducted, teaching the use of the pulmotor and various methods of rescue and resuscitation.

BERKELEY PARK *bathing beach, Denver, Colorado, one of the playground accessories, which is extremely popular with the young of all ages. Improvements are made on it each year.*

WORKERS IN THE FIELD

Dayton's Effort at Solving the Problem of the Unemployed

The Editor of MUNICIPAL ENGINEERING:

Sir—The general business depression during this winter found many worthy people without work. Some factories were running short time; all had lessened the number of their employes. The merchants suffered, as every one curtailed expenses. A bond issue of $250,000 for extension and reinforcement of the water system had been passed. Fifty thousand dollars additional was available, as this amount had been saved on water works construction done by the city employes during the past summer. This meant over $150,000 available for pay-roll purposes as soon as work was started, tho the pipe, valves and special fittings had not been ordered, as this work was to have been done after the weather opened up.

City Manager Waite gave orders that work would be commenced on Monday, December 21, this order being given the previous Thursday. It further called for the employment of 200 men, or as many more as needed the work or could be handled. Fortunately the contract for the pipe had been placed and the foundry was called on long distance and asked just what they could do. The result was pipe inside of four days and special castings for bonds, crosses and the like as soon as these could be completed. Notices were posted for all wishing work to appear.

Tags were prepared with serial numbers and districts stamped on same. (District A, 1843, for example.) These were given to all who applied at the office. Advice was furnished and notices posted for all to report at respective jobs called for on these numbers. As many men as could be handled were taken on the first day and the rest advised to come back in rotation as called for by the numbers issued. The men were paid off each day, and if their work had been satisfactory a new ticket with a number which put them at the bottom of the list was given each man. The majority of the men did most excellent work. It meant earning money for food instead of want or charity. They appreciated it and the effort the city was making to help them out. Cost sheets showed some of the work to have been done, with ground frozen eighteen inches deep, by men foreign to the business, for less money than that done by the old construction gangs under previous management. It was simply the American man doing his best and overcoming the obstacles.

The system furnished money for food, the men at first getting an average of one day's work in six. Almost every afternoon, as the men were paid off, many had either wife or child present with a market basket, and the money would immediately be turned over to purchase food. A number of days the men were paid off near saloons, and, in spite of weather as cold as 15 degrees above zero, no money appeared to go for liquor.

The pay roll was handled by a timekeeper who visited the jobs, took the men's names and inspected their numbers. With this data he and the chief clerk of the department of water made up the pay-roll. As the men changed each day, it was either a case of having them make an extra trip or else pay them that evening. The latter meant the easier for the men, so each afternoon the superintendent, who issued the work tickets, the cashier and the time keeper made the rounds. On reaching a job the foreman went through the gang with the pay men and each man received his $2 on receipt of his number and name, which was checked. After paying the men the foreman certified the men as having been paid, after first seeing that his own time book checked with the pay-roll. For six weeks we have paid daily from two to three hundred men, at places requiring over ten miles of driving in a small Ford car, and have never taken over two hours or held the men more than ten minutes over their eight hours.

The system was taking care of a thou-

sand men and doing a good work. The money paid went directly into circulation again and so worked many times. However, the system could be beaten, and men were doing it. In the first place, some men were not satisfied with work every four days and wanted more, and so worked two tickets at the same time, no check being provided over their issuance. In the second place, men who did not belong in Dayton obtained work, and so made less for the real Dayton men. The third problem was the foreigners, who swarmed after work.

The foreign problem was solved by allowing the foreign labor agencies and the foreign churches so many tickets each day. The repeaters were taken care of by simply catching the faces at first and putting them off the job for good, and later by checking each man's record. The third was taken care of at first by looking each man up in the city directory before giving him a ticket. Foreigners with property or naturalization papers were allowed to work. The idea was not to discriminate against them, but merely to help the men with families who needed it the most.

In order to reach those most needy, cards were gotten out containing the following information:

Name..... Address.....
Age..... Number Dependent.....
Occupation..... Last employed by.....
Time out of work.....

—To be filled out by Police Officer.—

Above satisfactory.....
Need Work.....
Time in Dayton.....

The card as indicated is filled out by the man and a number is given after the police officer has reported, which takes one day. A clerk in the office goes over each pay-roll and enters up the job the man works on, the date and the number used for the work. Also the report of the foreman as to nature of work done, the letters F, G, or P indicating whether the work was fair, good or poor. If a man gets two P's he is transferred to some other foreman, and if he again gets the two P's he is relieved from work. The actual work done is not considered as much as whether the man tries. We get old men who can not do the work and still need the money. The effort is what really counts.

Since the gang has been weeded out, we are giving one day's work in four. The men are posted as to their turns by bulletins issued daily and posted on the jobs and in the office, which show what is the low number to be called and the number of men that will be worked. That way men know when their turn comes without being there every morning, and so have chance for seeking better employment or doing other odd jobs.

The system is simple and it helps the men. The money goes into circulation at once and helps Dayton. One pipe gang laid twenty-six 12-foot lengths of 20-inch pipe in eight hours, all of which tested O. K. on the joints, so it is evident that the benefit is mutual. The work was started without knowing just how it would turn out and before a system was perfected. However, if every town would get the idea and go to it, the era of prosperity hoped for would be hastened.

H. C. Wight,
Superintendent, Division of Water,
Dayton, O.

City Managers in the West

The Editor of Municipal Engineering:

Sir—Following the installation of the city manager in Dayton, Ohio, cities and towns of the west became alive to the opportunity for advancement in municipal science. In a hundred places municipal officials and business men appropriated the good ideas that sifted out of Dayton and planted them as seed from which have grown the excellent systems now in vogue in a number of these places.

Montrose, Col., prepared to throw off the aldermanic form of government at the earliest possible moment, and early in 1914 the commission form was substituted with provision made in the charter for the position of city manager. The Montrose charter has been considered a model among towns of several states.

The Montrose charter, among other things, embraced initiative and referendum and recall provisions, and, while it gave the commissioners power to discharge the city manager, it also provided that the city manager should be subject to recall. While the framers of the charter looked forward to a much improved form of government that would be honestly and efficiently administered, they took no chances of having a contrary commissioner refuse to discharge a city manager if he was found dishonest or incompetent. The commissioners may elect the city manager by a majority vote, but can not discharge him except upon a unanimous vote. In that connection a clause of the charter is interesting, in that it gives the mayor the right to vote but deprives him of the right of veto. The Montrose charter clings closely to the old-time fundamentals of city government, but it embraces a lot of new ideas about management and details.

The Amarillo, Texas, charter calls for a standard of efficiency in the city manager that is extraordinary, for he may be oust-

ed from office over night. More than that, it provides that he "shall be the administrative head of the municipal government, and shall be responsible for the efficient administration of all departments. "Like most of the other late city charters this one prohibits the city manager from employing relatives in the service of the city. This charter steps out of the beaten path in another particular: It provides that the city manager nor any other person in the employ of the city must not accept free passes to theaters and other kinds of shows nor "accept a personal favor of any intrinsic value from any person, firm or corporation with whom he transacts official business, when such favor would be in recognition of his official position."

City Manager Hardin, of Amarillo, first suggested the idea of a congress of city managers. But that idea was second best among a number of ideas that have made Amarillo one of the best governed towns in the country. His best idea was that there should be a board of city development, and it bore fruit. A few months ago there was organized there the first municipal board of the kind in the United States. This board embraces twelve departments, each with a separate head. A secretary and an assistant secretary are employed full time to look after the business of the board. "In other words," says Hardin, "it is a chamber of commerce organized as a part of the city government and supported by all the people, and it works."

"My plan has been to eliminate all unnecessary help," says Manager Hardin, "and to require of every man employed a full day's work. But we have given men sufficient pay to make them like the work and take a pride in being a part of the city machinery. We have no old men on the city pay-roll and no pensioners."

The commissioners of Collinsville, Okla., and Abilene, Kan., being at the head of city governments where many municipal improvements requiring the service of an engineer were to be made, looked well into the engineering records of their applicants for city manager, and they probably have chosen two of the best that were available, if the accomplishments of these men are an index to their qualifications.

City Manager H. B. Schwartz of Collinsville was an engineer by profession, having begun his career in machine shops in Marion, Ind. He built the first light and power plant at Bartlesville, Okla., and was its superintendent for six years. He had also two years' experience in city government as a member of the City Council of Bartlesville. In 1912 he was employed as superintendent of the municipal light and water plant at Collinsville when it was earning a revenue of $240 a month. Under his management in less than two years it was earning a revenue of $1,700 a month. Later he acted as engineer for the city and made a saving of $2,000 engineering fees in making extensions to the light and water system and building a city hall. He has made a saving in every department of the city government, established efficiency and cut out the waste.

There seems to be no end to the powers and duties of the average city manager in this section. The charters are all about alike in this respect, but probably Abilene, Kan., has a slight lead. Here are the duties of City Manager Kenyon Riddle of Abilene:

To see that all laws and ordinances are enforced; to attend all meetings of the commisison, with the right to take part in the discussion but having no vote; to recommend to the commission for adoption such measures as he may deem necessary or expedient; to give all lines and grades for city improvements which require the same; to have control, management and direction of all improvement work of any nature which pertains to and comes under general engineering principles; to be inspector of all wiring, sewer connections and chimney construction; to approve all estimates of the cost of public works and recommend to the commission the acceptance or rejection of the work done or improvements made; to recommend to the commission the appointment or removal of all heads of departments and all subordinate officers and employes of the city which come under and pertain to principles of engineering; to exercise control over all departments and divisions created by the commission; to keep the commission fully advised as to the financial needs of the city, and to draw his salary.

Manager Riddle has prepared a symposium relating to the duties and qualifications of the engineer-manager. "The manager," he says, "should be without extensive interests in the community which he serves. This makes it possible for him to give impartial views in matters concerning employment of labor and purchasing material.

"His preparation should consist in a thoro education along the lines of general engineering rather than of a knowledge of a few special branches. He should have an understanding of values and be able to estimate all classes of construction and maintenance work, be economical and able to establish systems of record keeping and cost data and have a general conception of business methods and finances.

"Some of the dissipation of tax money is due to graft, etc., but most of it is the

result of poor management, lack of harmony among the board members and a lack of knowledge along particular lines, especially in the engineering department of smaller towns and in the purchasing department of nearly all municipalities. Therefore, in consideration of the small towns, the main object in order to secure efficiency where it is most lacking is to devise some scheme whereby the town can feel justified in having the services of an engineer at all times, and this remedy lies in the engineer-manager plan.

"With the engineer-manager it is possible to get the very best and most active business men to serve on the commission, since their duties are reduced to a few hours a week. Furthermore, it is generally admitted that the holding of a political job is not a successful means of increasing one's business, but under the new plan all complaints and grievances may be put up to the manager. By hiring a manager the hindrances of politics are eliminated and professionalism is substituted." W. F. Kerr,

Oklahoma City, Okla.

Motor Snow Plow and Sweeper

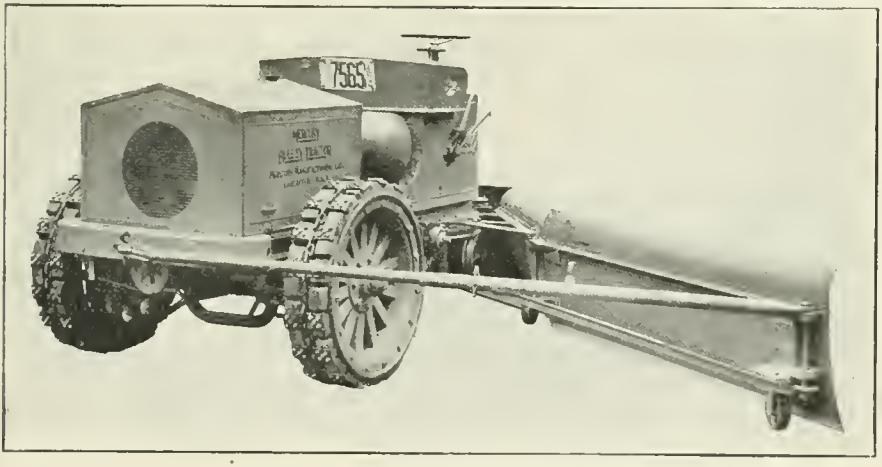
The removal of snow from city streets and drives is a costly but necessary procedure, and every hour's delay not only makes the final removal more troublesome and expensive, but adds to the difficulties of road vehicle operation. Every inch of snow decreases the efficiency of horse-drawn equipment, and the longer it remains on the streets the greater is the loss to merchants with deliveries to make and the more seriously is the public at large inconvenienced.

Were it possible to quickly plow out a roadway and bank the snow to the curb or in the center of the street, the final removal could be made more cheaply and traffic delays would be greatly reduced. If the street car companies did not send out electric sweepers as soon as there were indications of a heavy snowfall, the lines would be hopelessly blocked in a few hours. To do the same for the lines of other vehicle traffic motor-driven snow sweepers and snow plows must be used. The power unit must be compact, sturdily built, easily manipulated, capable of securing traction on any kind of snow or ice-covered street without injury to the pavement, and of sufficient power to break up frozen drifts. A tractor with these qualities can push the snow plow, a rear view of which is seen in one of the photographs, or draw the sweeper seen in the other.

The snow plow resembles the very effective railroad plow more than the ordinary road scraper quite generally used. In the road scraper there is a single blade set at an angle, slightly curved and rigidly attached to the vehicle, but capable of being adjusted vertically by the operator, and in some cases a change of angle is possible. The plow shown in the photographs is flexibly attached to the power unit, rests upon its own wheels, and is free to articulate and conform with the road surface, regardless of the position which the tractor may assume.

The V-shaped main member in front is properly formed to lift and displace the snow to the best advantage, and an arm eight feet long is attached to the right-

REAR VIEW *of motor snow plow, showing method of flexible attachment of extension blade carried on two small wheels.*



hand rear of the V-shaped piece, which is easily adjustable so as to increase or decrease the throw of the plow. The main member may be used without the extra arm. The rear ends of the main member are supported on two caster wheels, and the front on a flanged guiding wheel, mounted on a fork and turned by a gear and wheel arrangement directly attached to the tractor steering turntable. The framework is of heavy channel and angle iron, riveted and welded together. The heavy bent plates forming the blades are riveted in place and reinforced by channel-iron ribs and angle-iron lengthwise members. There is less than than one-half of an inch clearance between the plow and the ground, which insures a clean street. The V end is fitted with a strong prow, so that when an obstable is met which cannot be plowed aside, the plow either mounts over it or sheers to one side.

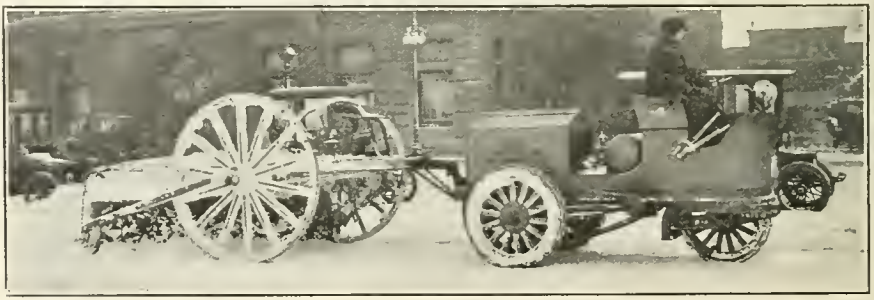
The snow plow is attached to the tractor at three points, but none of the connections are rigid. A detachable forging is fastened to the front of the tractor by two bolts and thru a hole in this forging the vertical driving post of the snow plow passes. The rear end of each side of the main member is flexibly attached to the tractor frame by a bent round iron passing thru a swivel bolt. The flanged guiding wheel, located just behind the point of the plow, is actuated by two heavy steel wire cables attached to the tractor steering turntable.

The extra plowing arm may be attached to the rear end of the right side of the plow by a long swivel bolt. The rear end of this extra arm is supported on a caster wheel and connected with the rear of the tractor by a braced, telescopic extension rod. The length of the rod can be quickly adjusted to give the extra arm a throw of from nothing to six feet.

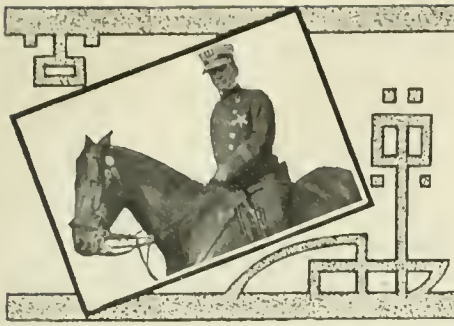
MOTOR SNOW PLOW *clearing park driveways of deep snow. Note ease with which it handles the snow.*

When entering a wide street the plow first opens up a furrow from 8 to 14 feet wide, depending on whether the extra arm is swung open or not, then it returns on either side and banks the snow against the curb.

Two of the tractors, one equipped with the snow plow and the other drawing a snow sweeper, as shown in the photographs, were used in cleaning Michigan avenue, Chicago, during the heavy snowfall January 20 and 22. With suitable approaches they mounted the wide sidewalk along Grant Park and first plowed out a passageway and then swept the walk clean. When the snow first began to fall, the motor-drawn sweeper cleaned up the avenue easily, but the storm increased and the plow went to work, first opening up a passageway, and then banking the snow at the curb and also in the center of the street. The sweeper followed and left clean pavements for the automobiles.



MOTOR SNOW PLOW *drawing a sweeper to clear the pavement after the plow has done its work.*



LEGAL DECISIONS

Decisions of the Higher Courts of Interest to Municipalities

City Must Supply Water at Same Rate to All.—A city which constructs, as authorized by statute, a water supply system for its inhabitants and for territory outside the limits, must furnish water to all consumers, whether within or without the city, at the same rate, in the absence of some physical difference justifying a separate classification of those consumers who reside outside the city limits. City of Montgomery v. Green et al. (Ala.), 65 So., 783.

Alley May be Appropriated for Parkway.—Where the state conferred its full powers of eminent domain upon a municipality which power applies to every species of property, except as limited by the state and federal Constitutions, the municipality may condemn a public alleyway for a parkway, for the municipality already owns the public easement, and the private easements of abutting owners are private property subject to condemnation. Chaplin v. Kansas City et al. (Mo.), 168 S. W. 763.

Harrisburg Filters Do Not Infringe Patents.—The Jewell reissue patent, No. 11672, for a filter for municipal or other large waterworks plants, and the Jewell patent, No. 644137, for the method of purifying water by the use of such filters, held not infringed, on uncontradicted evidence that experiments conducted during six months with the alleged infringing filters in use by defendant city, while being operated in the customary manner, failed to show the characteristics claimed to be inseparable from the operation of the patented apparatus and method. "Positive head," as used in connection with a filtration plant, means the weight of the water, both within and above the sand bed, and is usually measured from the controller or the under drainage system to the surface of the water to be filtered. "Negative head," used in the same connection, means the force that comes into play when a partial vacuum is created, either within or below the filter bed. Sand of "effective size," as used in connection with a filtration plant, means sand containing 10 per cent. by weight that is finer in grain than the diameter sought to be secured. City of Harrisburg (Pa.) v. Continental Jewell Fltration Co., 217 Fed., 366.

Discretion of State Public Service Commission.—Where the public service commission ordered a waterworks company to terminate a contract by which it had agreed to furnish water to certain mills free for forty-nine years, after a hearing of which the mill companies had no notice, and later the mill companies intervened and showed that the contract was executed in consideration of the transfer by the mills to the water company of the water plant, though there was no reservation of the right to use the water in the deed of transfer, it was not abuse of the commission's discretion to set aside the former order directing the termination of the contract. State ex rel. Raymond Light and Water Co. v. Public Service Commission of Washington et al., 145 Pac., 215.

Damages for Change of Established Grade by City.—Where a city by ordinance has established a street and curb grade for both roadway and sidewalk, both the city and adjoining property owners were bound to conform to such grade, and the city after such conformity could not change the grade without payment of damages resulting to the property owners thereby, but abutting owners could not recover damages for the destruction of their old sidewalks so far as they did not conform to the official grade, but were entitled to recover such damages as resulted solely from lowering the sidewalks contiguous to their property below the established grade. Ludwigs et al. v. City of Walla Walla et al., (Wash.) 145 Pac., 193.

Excessive Water Charges May Not Forfeit Franchise.—A violation by a public service corporation supplying water of Const. art. 14, secs. 1, 2, prohibiting the collection by public service corporations of a rate for water in excess of that fixed

by a city council, does not, ipso facto, work a forfeiture of the works and franchises of the corporation, and it may thereafter collect same charges for supplying water. Hatfield v. Peoples Water Co., (Cal.) 145 Pac., 164.

Liability of Municipality for Overloading Surface Drain Is Limited.—Under St. 1909, c. 269, authorizing a town to construct a drainage system and to maintain subdrains discharging water into any brook, and to deepen, widen, and clear of obstruction any brook, etc., and by sec. 5 made liable for damages therefrom, a town which took and paid for the right to lay and maintain a subdrain thru plaintiff's land to a brook did not thereby make the brook a common drain, and have the right to enter upon private land to clean it of obstructions, and was liable only for causing an overflow of the brook and the flooding of plaintiff's land, and not for damages resulting from an obstruction not caused by the subdrain. Diamond et al. v. Inhabitants of Town of North Attleboro, (Mass.) 107 N. E., 445.

Town Liable for Overflow of Standpipe.—Regarding a town's liability for overflow of its standpipe onto adjacent property, tho the regulation valve, clogging of which occasioned it, was under control of the metropolitan water system, with the conduits of which the town's service pipes were connected, yet it being unquestioned that, if foreign substances in the water passed into the valve, it would cease to work automatically, and leak, flooding the standpipe, and there being evidence that an overflow pipe, which would have prevented the damage, was feasible, the jury could find the town reasonably ought to have anticipated and guarded against the condition. Kelly v. Inhabitants of Town of Winthrop, (Mass.) 107 N. E., 414.

Town Liable for Negligence of Waterworks Employe.—Within the rule that a municipality is liable for negligence in operation of a system of waterworks if it is operated as a commercial venture, it is immaterial that the city may not make a profit, if in its essential nature it was to be operated for a profit, and it could not escape liability for negligence in operation in that it was to get a portion of its supply of water from the metropolitan water system, which was entitled to the immunities of a governmental undertaking. Pearl v. Inhabitants of Town of Revere, (Mass.) 107 N. E., 417.

Water Company Not Required to Supply Beyond Area for Which Intended.—A state commission is without power to order the owner of a water system, constructed and operated only to supply residents on certain lands, to connect such system with other consumers and furnish them with water, where there was no evidence to warrant a finding that the supply of water was more than required to properly serve the consumers for whom it was intended. Van Dyke et al. v. Geary et al., 218 Fed., 111.

Liability for Damages for Grade Crossing Elimination.—Where a municipal corporation changes or regrades its streets, and does so skillfully, without trenching on the property of adjoining owners, it need not pay consequential damages, since abutting owners hold their property subject to the right of the city to make such changes in the grade of the highway as public convenience may require. If it is to eliminate a grade crossing, for convenience of the general public, an abutting owner cannot recover from the city because the change in the grade resulted in the greatest benefit to the railroad company. If the railroad company had nothing to do with the work of changing the grade, it is not liable to an abutting owner, tho it is greatly benefited; but where the city gave its consent to the construction of an approach to a bridge by the railroad company, and the company voluntarily did the work for its own interest, it is liable to an abutting owner in damages, where the approach rendered access to his property by an alleyway more difficult. Baltimore & Ohio Ry. Co. v. Kane et ux.; Mayor and City Council of Baltimore (Md.) v. same, 92 Atl., 532.

Sewage Farm for Ontario, Cal.

The city of Ontario, Cal., has purchased 175 acres of land at $225 an acre on which to discharge its sewage for irrigation and fertilization purposes. The city then leases the farm to E. A. Parkford, from whom it is purchased, at $3,150 a year for 25 years with two years rental in advance, the city to deliver its sewage to the farm without cost to him.

Motor Vehicles

The Motor Truck in Road Building

MOTOR trucks effect a large saving in the cost and reduction of the time in every road-making operation. County commisioners and road contractors are using such trucks in grading, leveling, dragging, surfacing and rolling roads, as well as in hauling, dumping and spreading road material. Gasoline trucks will do all of this work cheaper than it can be done by any other method.

The wide steel wheels of the trucks shown in the photographs enable them to operate on soft, fresh-made surfaces or in pits where snatch-teams would be needed for horses, hauling five tons of material.

A 5-ton truck can pull two of the heaviest graders 40 miles a day and pulls a 16,000-pound drag, covering a road width of 36 feet, 50 miles a day. It also packs and rolls the surface with its broad steel wheels replacing the road roller. It pulls trailers when conditions are suitable and is used to transport gangs, tools and supplies.

In Nuxebee County, Mississippi, the prevailing cost of gravel hauling in road work has been $1.70 per ton, when the haul did not exceed six miles. On this basis a recent job of hauling 448 tons from gravel cars at Brooksville to a road job six miles distant would have cost the county $762.60, and the work would have been extended over a long period. Instead of using mules, however, the board of supervisors used a good roads truck and the work was done in ten days, with a saving of $527.23. The total earning under the contract price would have been 448.65 tons at $1.70 per ton, or $762.70.

The operating expenses included:

376 gallons of gasoline at 19c	$71.44
36½ gallons of oil	13.86
Grease	2.70
Total for fuel	$88.00
Negro labor at $1.50-$1.75	84.67
Driver	62.50
Total	$235.17

leaving a gross profit of $527.53.

The wages for the driver are given as $62.50 for 10 days, whereas drivers can be obtained for $75.00 per month. The three road commissioners for this district express their belief that the county can build roads cheaper with these trucks than they can be built by letting contracts.

The commissioners of Cabarrus County, North Carolina, made a test in which 26 miles of road were rebuilt in 43¼ hours. At the conclusion of the test, Superintendent of Roads J. M. Bunage made the statement that the work was done better than by any previous method. Three different kinds of roads were worked in this test—clay, sand-clay and macadam. The commissioners first unloaded 80,000 pounds of cement, and the truck hauled this material one-third of a mile over a muddy road, including a 4 per cent. grade. Then, in eight successive days, the truck pulled graders and drags on a stretch of road 26 miles long. Every part of the road was graded, dragged and rolled. The ditches were cleared and remade by pulling thru the ditches once on each side after the original grading and dragging had been done. In rebuilding 26 miles of road, the truck traveled 202.5 miles. The total cost for fuel and oil was $48.93. Only two men were employed, the driver of the truck and the operator of the road machinery.

A record for high speed and economy was made in dirt road construction in Guilford County, North Carolina, where, among other results, 2½ miles of road were built in seven hours. One of the heaviest types of road graders was used to cut a hard top soil road, but the truck had no difficulty in pulling the grader at the desired speed, turning up earth as required by the superintendent.

Mule power was pitted against motor power for nine days in a test in Putnam County, Florida. Eight mules were placed

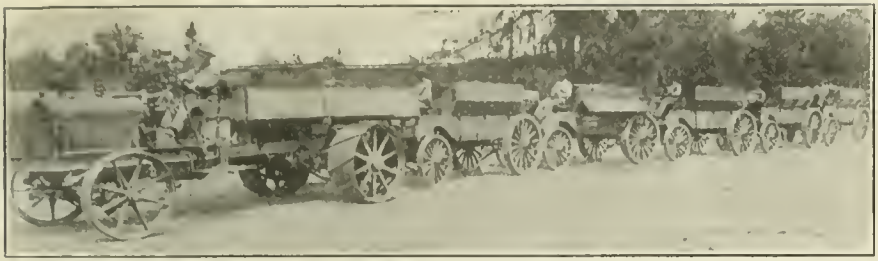
FIVE-TON TRUCK *on road work in Cabarrus County, N. C. Convict labor is used. Note the steep hills to the fill at the bottom to reduce the grades.*

in direct competition with a 5-ton truck, pulling graders and three-way drags over a road which had no hard surfacing, but a large proportion of sand. The result of this test showed that the motor truck, on the same expenditure, did five times as much work in the same time as the eight mules, or, in other words, the truck did the same volume of work at one-fifth the cost of using mules. While eight mules graded and dragged 77½ miles in 90 hours, the truck graded and dragged 161 miles, and, in addition, the smooth, broad wheels of the truck rolled 256 miles. If mules had pulled a 5-ton road roller 256 miles, in addition to grading and dragging as much as the truck, it would have required, as shown by the test, 35¾ days, and the cost would have been $536. The cost of doing this work with the motor truck was $101.90, or $11.77 per day.

In the construction of one test road the entire subgrade was plowed soft. With a full load, the truck was run over the subgrade four times and the broad steel wheels rolled the subgrade smooth.. Then the gravel was dumped and spread, beginning at the point nearest to the gravel car. As the loads were hauled to the progressive dumping points, the fully loaded truck, driving over gravel that had already been dumped and spread, packed it down thoroly. Thus the dumping and rolling are done simultaneously. The hauling of the gravel cost 7½ cents a yard mile, the average of 32,067 yard miles.

The highest economy in stone road construction has been achieved by the pike commissioners of Polk County, Tennessee, by taking full advantage of the manifold uses of two 5-ton trucks. Stone of three different sizes for sub-grade and surfacing was hauled, dumped, spread and rolled. The hauling and dumping was done in the quickest possible time by reason of the simplicity and speed of the power dumping mechanism. Rapidity in spreading added greatly to the speed and economy of the work. The first grade was very coarse, the second medium and the third practically dust. The automatic dumping and spreading truck was utilized in this method of sorting, loading and applying the stone. After the road has been properly prepared with a grader, the coarse stone is hauled to the job. The power dumping mechanism elevates the body to an angle of 47 degrees, and the driver pulls a lever which trips the tail-gate at the moment the truck starts to move. In this manner the dumping and spreading are automatic, and the material is applied evenly as to width and thickness. This stone is then rolled by the truck. In exactly the same manner a layer of the medium size stone is spread and rolled, after which a layer of stone dust is applied. When sprinkled and rolled the surface becomes smooth, hard and thoroly bound.

Serious problems in road maintenance have been solved by a similar truck in Orleans County, Louisiana, in a striking manner. A hard shell road, leading out of the city of New Orleans, which had been built through a swamp for three miles at a cost of $90,000, became so full of waves and holes, after seven years' use, that a motor car could not be driven faster than twelve miles an hour with any degree of comfort or safety. It was



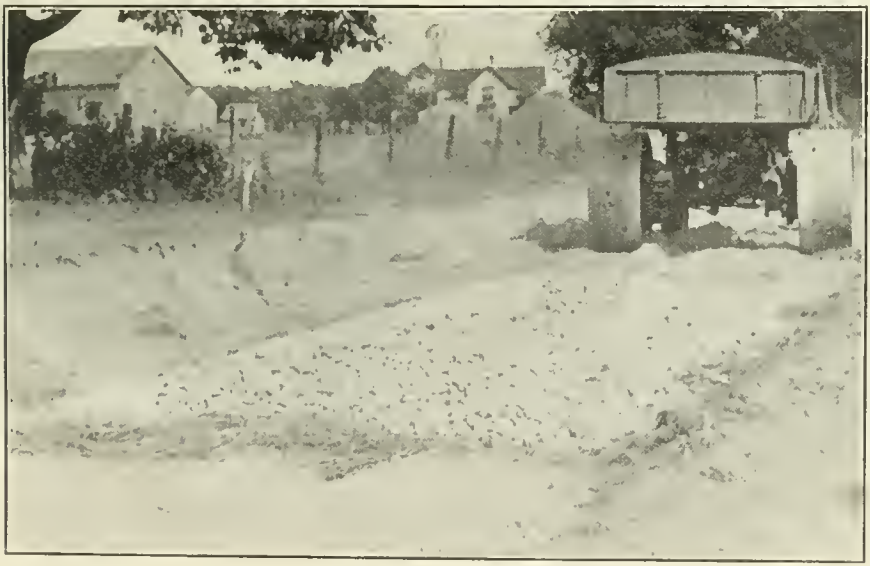
FIVE TRAILERS *hauled by a five-ton truck, all loaded, on road work in Chatham County, Georgia.*

believed that the road would have to be scarified and rebuilt. But, immediately after a soaking rain, a grader was attached to the truck, and, in cutting, the blade of the grader was sunk into the bed of shells, making a furrow four inches deep. After one circuit, cutting and clearing the furrow, the truck made two other trips, moving the loose shells and binding material toward the crown of the road. At the same time the blade of the grader cut off the high spots and filled up the holes. The smooth steel wheels of the truck packed the material thoroly and rolled it smooth. The condition of the binder was such that the material cemented exactly as it was left by the machine. With one day's work the surface of the road was made hard and smooth. Automobiles were driven over it faster than 35 miles an hour with perfect comfort.

When the commissioners of Chatham County, Georgia, used mule teams, it required anywhere from four to six weeks to build one mile of permanent road. With the motor truck and roller-bearing trailers, they build a mile in four days, with a tremendous saving to the county. Fifteen mule teams and a large percentage of the drivers have been eliminated. The Chatham county commissioners conducted a test of 45 days' duration, hauling Augusta gravel, which weighs 2,700 pounds per cubic yard, a distance of 1.15 miles. The truck was tested for 411 hours, and it moved 4,023 tons. This tonnage was handled at the rate of 89.4 tons a day.

Total number of tons	4023.0
Total number of miles	1662.5
Miles per gallon of gasoline	1.5
Miles per gallon of oil	23.0
Total cost of operation	$459.52
Cost per ton	.112
Cost per ton-mile	.10
Cost per yard	.1542
Cost per yard-mile	.134

MOTOR TRUCK *has dumped and automatically spread a load of broken stone on a road at Berrien Springs, Mich.*



A motor truck hauled shell at 12½ cents a yard in a test in Volusia County, Florida. The truck did the work of 13 double teams, drivers and wagons, the average cost of which is $5.25 per day for each team, driver and wagon. This represents a gross saving of $68.25 per day. In this test the truck hauled periwinkle shell for road surfacing, the length of haul being 1.08 miles, or 2.16 miles per trip. The total amount of material to be moved was 430 tons, or 573 yards, and the truck hauled 53¾ tons per day, completing the work in eight days. The actual running time, however, was only 28 hours. The time consumed in loading and other losses of time totalled 61 hours. The total cost of operation was $71.80 and the cost per yard mile was found to be 11.6 cents.

More Gasoline from Petroleum

Dr. Walter F. Rittman, chemical engineer of the U. S. Bureau of Mines, is announced by Secretary Lane, of the Department of the Interior, as the discoverer of a process for producing gasoline in refining petroleum which will increase the gasoline product 200 per cent. or more. The process will be patented and the patent dedicated to public use. The Standard Oil Company has operated such a process for some time and the free use of the new patent will put other oil producers on a par with the Standard in this particular.

New Motor Fire Apparatus in Boston

According to a recent statement by John Gradey, fire commissioner of Boston, Mass., the department is receiving a large amount of new apparatus. This includes the following:

A new 85-foot aerial truck, motor driven, built by the Seagrave Company, of Columbus, Ohio.

Water tower No. 3, attached to an American and British tractor, which ran over the roads from Providence to Boston.

A Robinson tractor, attached to aerial ladder truck No. 14.

A Robinson tractor for aerial ladder truck No. 15.

Robinson motor pumping engine No. 41 showed its ability to do good work in the worst snow storm of the winter on January 25. On account of second and third alarms from Roxbury, it was moved from House 41 to 33 and again to 13, and while there it responded to an alarm, arriving at the fire promptly and helping to extinguish it. The ease of its operation is reported as materially greater than that of horse-drawn apparatus.

The three water towers in the department are equipped with American and British 2-wheel tractors. They weigh about 9½ tons each and they were run over the roads from Providence to Boston, one of them immediately after a heavy snow storm. They have been successfully tested on steep Parker Hill avenue, covered with snow and ice.

A Trackless Trolley Car

The accompanying photograph shows a trackless trolley car in operation in Gmuend, Austria, in winter. This method of propulsion of vehicles seems to be fairly successful, and where roads are good but the traffic is not sufficient to warrant street or interurban railway lines, there should be quite a demand for them. The permanent structure being only the overhead wires and the poles supporting them, these lines are much less expensive than cars running on tracks. They are more expensive to construct than automobile lines, but possibly, if electric current is cheap, the operation charges might be enough less to make up the difference.

ROADS AND PAVEMENTS

Good Roads Year Book

More than two hundred million dollars of state appropriations have been expended to January 1, 1915, and an approximate total of 31,000 miles of surfaced highways constructed under state supervision since the inauguration of the policy known as "State Aid," according to the Good Roads Year Book for 1915, to be issued in March by the American Highway Association, from its Washington office. Only seven states ,namely, Florida, Georgia, Indiana, Mississippi, South Carolina, Tennessee and Texas, have no form of state highway department whatever, but Georgia grants aid to the counties for road improvement by lending the services of the entire male state convict force. Legislatures now in session are devoting much attention to road legislation and unquestionably several new highway departments will result. North Carolina will probably establish an independent highway department in lieu of the work now done by the state geological survey relating to highways.

New Jersey in 1891 was the pioneer in providing state aid for public highways. Massachusetts and Connecticut adopted the policy shortly after, but only during the past ten years has the state aid policy been in effect on a considerable scale. About 5,000 miles of state highways were completed in 1913 and about 6,000 miles in 1914, so that the past two years have been responsible for more than a third of the entire state highway mileage. The state highways in America now exceed by 6,000 miles the national road system of France.

To have state highway departments placed under non-partisan, efficient control; skilled supervision required in all construction work; a proper classification of highways to insure intelligent distribution of improvements; an adequate provision for maintenance of highways from the day of their completion—these are among the objects for which the American Highway Association is waging a vigorous campaign.

Municipal Terminals for St. Louis

The franchise of the Terminal Railroad Association of St. Louis for the tracks it occupies on the river front expires next December and the city officials are studying the problem of railroad and water terminals with reference to the establishment of municipally-owned and operated facilities for such terminals and the exchange of traffic between land and water vehicles. Several members of the administration have made a trip down the Mississippi river to study the terminals, especially the municipal docks and belt railway at New Orleans, which furnishes what is in many ways an ideal system of interchange of traffic.

Speakers at the River Terminals Conference, held in St. Louis, September 19, advocated modern cranes and lifting devices for transferring freight from car to boat or the reverse, the most expensive operation involved, that the terminals should be owned by the municipalities and that the fees for their use should be the least necessary to pay maintenance and sinking fund charges.

Grade Crossing Elimination in Dallas

The board of city commissioners of Dallas, Texas, has passed orders taking the first steps toward the elimination of many grade crossings in the city in accordance with the only amendment to the city charter adopted out of thirty-four submitted to the voters in January, 1914.

The city attorney has been instructed to notify the railroads to appear and city engineer J. M. Preston has been asked to prepare a report on the results of his investigations of the subject, utilizing to the fullest extent the new union passenger station. Most of the construction promises to be in the shape of viaducts leading the streets over the railroads, tho the park board is working on a subway under the tracks of the M., K. & T. railroad at one crossing.

An Ornamental Park Bridge

Attractive features in and about the approaches to our cities serve the useful and commendable purpose of creating on the mind of visitors a pleasing impression of the community.

Too often, however, the districts adjoining the railway depots and boat landings are given over to purely utilitarian purposes, and little or no thought given to their ornamentation. Where conditions will at all permit, there are few features more appropriate at the railway station than an open space with drives and foliage, laid out by the landscape gardener. The visitor on emerging from the train is then greeted by welcome foliage and flowers in the summer, and in winter is permitted to have an unobstructed view of the surroundings.

In open spaces of this kind, an ornamental bridge is an interesting feature, contrasting with the foliage and the water beneath it. The one shown in the accompanying illustration is at Madison, N. J., and crosses two lines of railway, where they pass in a cutting thru the park. The bridge is surrounded by bushes and foliage, and at night is illuminated by electric globes. It is the work of H. G. Tyrrell, bridge engineer, of Chicago and Evanston.

Finances of Taylor, Tex.

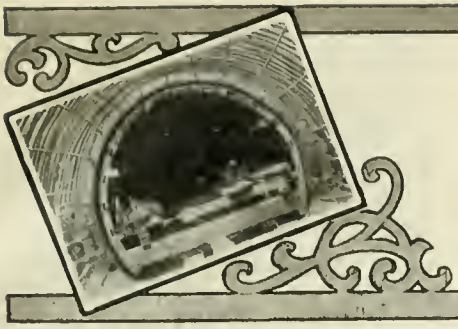
Peter Schramm, city manager of Taylor, Texas, has made a report of the financial result of the operations of the city from May 19, 1914, to February 19, 1915, which is very encouraging. He received from the old city council on the former date, $181.94 in the general fund, and now reports a balance of cash in hand of $3,466.27, after paying $8,278.74 of old bills. The total expenses for the period were $24,275.79, including the old bills referred to.

Development of Wire-Cut-Lug Brick

In 1910, the Dunn Wire-Cut-Lug Brick Co. started with one licensee making brick under the Dunn patents, 55,825 square yards of pavement were laid, and 2,233,000 brick were sold. This form of brick has so fully demonstrated its value that on January 1, 1915, there were twenty-six licensees operating forty-two plants, and new plants are added at frequent intervals.

The phenomenal growth in the business is shown by the following tabular statement:

Year	Bricks sold	Yds. of pavement laid
1910	2,233,000	55,825
1911	7,572,250	189,306
1912	25,023,904	625,597
1913	36,912,320	922,808
1914	104,885,745	2,622,143
Totals	176,627,219	4,415,679



CONCRETE

Fire Resistive Value of Concrete

A committee of the American Concrete Institute, composed of Cass Gilbert, architect, New York, past president American Institute of Architects; E. J. Moore, chief engineer, Turner Construction Co., New York; Walter Cook, consulting architect, Board of Estimate and Apportionment, New York; past president American Institute of Architects; James Knox Taylor, formerly supervising architect, U. S. Treasury Department, Washington; Rudolph P. Miller, formerly superintendent of buildings, Boro of Manhattan; William H. Ham, consulting engineer, Boston; Charles L. Norton, consulting engineer, professor of heat measurements, Massachusetts Institute of Technology, Boston; Richard L. Humphrey, consulting engineer, Philadelphia, past president American Concrete Institute; with Mr. Gilbert as chairman, has made a report on the fire of the Edison plant at West Orange, N. J., from which the following is taken:

"The fire fully demonstrated the advantages of monolithic structures. The fact that at five different places several of the wall columns were rendered useless and yet the upper portions of the building stood intact, is evidence of the superior merits of concrete in monolithic construction.

"Considering the extraordinary conditions surrounding this fire, the behavior of the concrete buildings was highly satisfactory and constitutes an excellent demonstration of the merits of concrete as a fire resisting building material. It is not so surprising that the concrete buildings were damaged as that any material should have so satisfactorily withstood these unusual conditions.

"The end walls in the three upper floors of two buildings extended above the roofs of the adjoining buildings, which were completely destroyed; while this was in the hottest part of the fire, the walls were practically undamaged and are an admirable demonstration of the value of concrete walls as a fire barrier.

"The fused metal found in different parts of reinforced concrete buildings would seem to indicate that the fire reached an intensity of 1000 degrees F. in all these buildings, and in many cases as high as 2000 degrees F.

"In the greatest portion of these buildings the concrete remained firm and hard and intact after this severe heat treatment."

Mr. Edison says that 87 per cent. of the reinforced concrete buildings, which were subjected to very intense heat, are in good condition and about 65 per cent. of the machinery they contain can be used with small repairs.

Construction of Mile Rock Tunnel, San Francisco

There is under construction in San Francisco, a horseshoe shaped sewer 9 by 11 feet. The sewer is being constructed mostly in tunnel, which is approximately 4,380 feet long on 0.1606 grade per 100 feet. The tunnel extends north from Carrillo street under Sutro Heights to its outfall in the Pacific Ocean.

The excavation work and the concrete lining are being handled from two adits, one of which is at right angles to the tunnel and the other making an angle of 20 degrees with the center line. The distance between adits is 3,116 feet.

The work is being carired on from both ends in three shifts of eight hours each, two shifts being devoted to the excavation work and the third shift being devoted to concreting by the compressed air method. The south heading is in hard blue shale, and the north heading is also in blue shale, but has passed thru blue sandstone.

The drilling in the south head is done by two "Little Jap" hand drills and 25 to 30 pounds of 40 per cent. dynamite is used per round. In the north heading, where the rock has been harder, two piston drills mounted on columns have been used and an average of eighteen 6-foot holes drilled, requiring from 50 to 70 pounds of dynamite per round.

As shown in the accompanying photograph timbering is used which consists

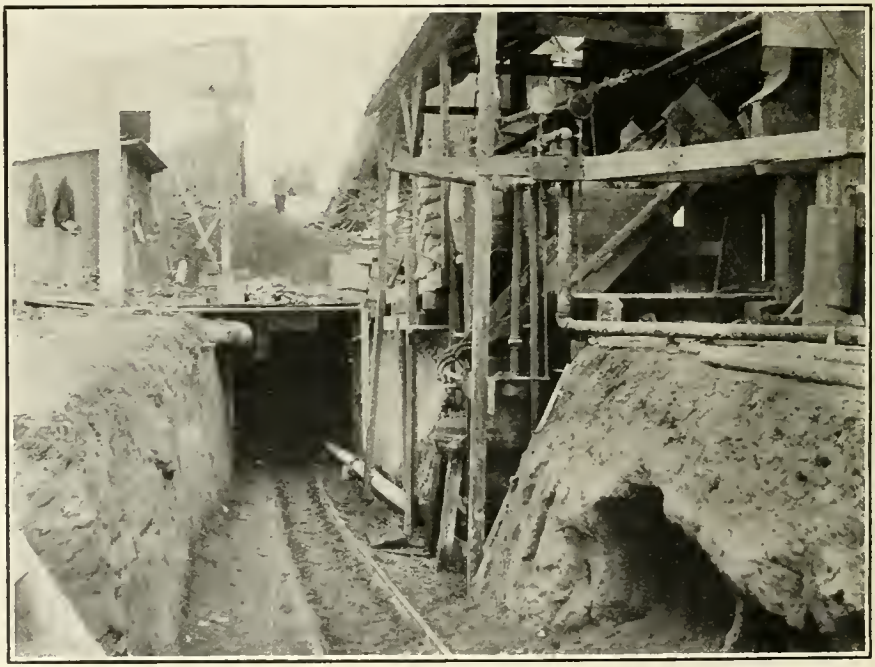
VIEW OF THE INTERIOR *just ahead of the forms showing the concrete pipe as it emerges thru the forms and turns up and back thru the bulk-head, delivering the concrete in place at the crown of the arch.*

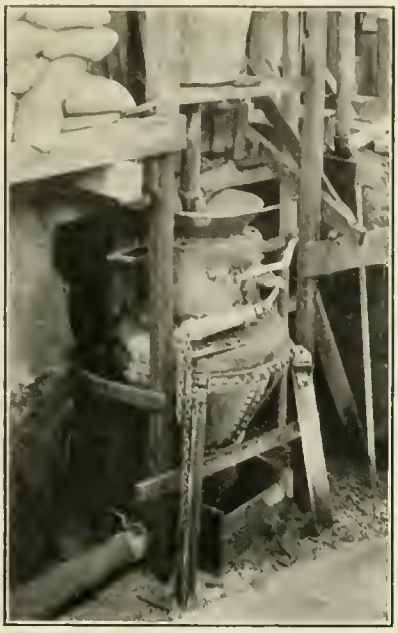
CONCRETE MIXER AND CONVEYOR *and loading plant as built at the adit to the tunnel.*

of a two-post five-segment arch of 8 by 8 timbers spaced about five feet centers. Lagging is used only in bad spots.

Mules are used to haul up the muck which is placed in ¾-yard narrow-gage cars and wasted near the mouth of the adits.

The concrete work is following the heading and the compressed air plant used to supply power for the drills is also used for supplying air for mixing, conveying and placing the concrete in the forms. The compressor is an Ingersoll-Rand two-stage machine with a capacity of 1,100 feet of free air per minute with a receiver at the mixing and conveying machine of 120 cubic feet capacity. The mixer and conveyor is placed in a niche at the side of the adit, and receives material by gravity from bins erected over it. The material for each ¼-yard batch is measured in a hopper directly above the machine and is dumped into the machine, together with the proper amount of water for the batch. The machine is then closed at the top by means of a flap door operated by an air cylinder. The machine operator then turns on the air, which enters the machine practically simultaneously above and below the batch and conveys the batch thru the delivery pipe from the machine thru the tunnel into the forms. This pipe passed along the floor of the tunnel thru the forms, where it turns up with a 90-degree bend and back with a 90-degree bend, entering





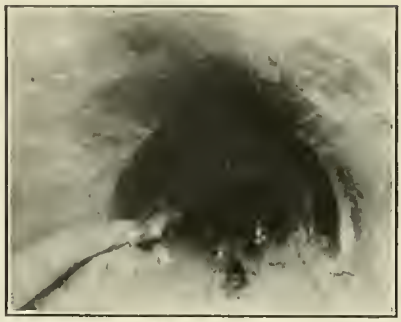
NEARER VIEW OF MIXER *and conveyor. Two men handle all the work at this point.*

the forms at the crown of the arch. A heavy rubber hose about 4 feet long is used on the end of the pipe for distributing concrete. The conveyor pipe is now about 1,300 feet long, but it is intended to extend it to about 2,000 feet. At the present distance about 32 batches of concrete are averaged per hour, but at 600 feet distance the average was about 60 batches per hour.

The finished arch is a very dense concrete, as shown in the accompanying view. The velocity of material projected into the previously placed concrete makes the concrete of great density and also forces the grout against the surface of the forms.

The number of men engaged in the excavation work in each heading consists of one foreman, four miners and six shovelers. The number of men engaged on the concrete work consists of two men on the mixer and two men at the forms. Electric signals are used between the forms and the mixer for regulating the operations. The concrete material is a 1:2¼:5½, when a 2-inch gravel is used.

The contractors for the work are R. C.



SHOWING COMPLETED LINING *and concrete conveyor pipe at lower right hand and ventilating pipe at the left.*

Storrie & Co., of San Francisco. The Pacific Concrete Placing Company, of San Francisco, are the contractors for the concrete work. Pneumatic machines for mixing and conveying concrete are leased by the Concrete Mixing & Placing Company, Chicago. The work was started in August, 1914, and the construction part will cover about one year.

Alien Labor Law Sustained

The New York Court of Appeals has upheld the alien labor law of that state, under which the contractors say that aliens cannot be employed on public work and that contracts for such work will probably rule somewhat higher in that state as a consequence.

Sewage Disposal for Fort Worth

It is estimated by Henry and Gregory, consulting engineers, that complete sewage disposal works for Fort Worth, Texas, including a new main outfall sewer, will cost $782,000. The plant would have a capacity of 12,500,000 gallons a day and would treat the sewage of Fort Worth and Polytechnic and the liquid refuse from the packing houses. Outfall sewer and clarification section of the disposal plant, costing $363,000, could be built first and the rest of the plant later, as desired. Charles Saville, C. E., now of Dallas, Texas, aided in the survey and report, which also covered garbage and refuse collection and disposal and street cleaning.

WATER

New Water Supply for Salem, Mass.

After the great fire of June 25, 1914, in Salem, Mass., that city decided to install a high pressure water system and increase the supply by a new reservoir and an auxiliary canal from the Ipswich river. The two projects are to cost about $500,000 and according to Patrick J. Kelley, director of public works, will be completed by January 1, 1916.

At the present time the normal water pressure of Salem is 50 pounds. On June 25, 1914, this fell to 40 pounds and in some instances even lower. Under the new plan the pressure will run from 85 to 90 pounds. This pressure will be obtained by building a new reservoir on Mt. Burnet, which is familiarly known as Folly hill, in the town of Danvers. This hill is four miles from the center of the city. The reservoir on its top will be about 210 feet above sea level, will be of concrete, 400 feet by 150 by 25, and of 10,000,000 gallons capacity.

At Wenham lake will be erected a new pumping station to raise the water from the lake into the new reservoir on Folly hill. In conjunction with the new supply the entire city is to be equipped with iron pipe of larger dimensions than formerly, replacing all the old cement-lined pipe. Already about two-thirds of the city has been equipped.

The estimated cost of the high pressure service is: For reservoir and land damages, $125,000; pumping plant, $75,000; new pipe line, $150,000.

The second proposition regarding the water supply contemplates increasing the amount of water brought into the city by taking excess flowage of the Ipswich river. This involves an expense of $150,000 and as Beverly is interested in the latter project it will bear one-third. In both instances provision has been made for the payment of the costs by bonds maturing in 30 to 40 years.

The present supply and storage basin of both Salem and Beverly is Wenham lake and the present daily average consumption of Salem and Beverly together is about 5,000,000 gallons. The auxiliary supply for Salem and Beverly jointly was authorized by the state legislature in 1913. There is a bill in the legislature now to change the point of intake on the Ipswich river a half mile nearer Wenham lake and save $50,000 in construction. The water will be run thru an open ditch 1½ miles long by gravity to a point 2,300 feet from Wenham lake. Being then 15 feet below the lake level, it will be passed thru a pumphouse, to be installed, and delivered into the lake thru a 2,300-foot concrete culvert. This pump will have a capacity of 2,500,000 gallons a day. Under the state grant the city may pump from December 1 to June 1. The Ipswich river has a watershed of something like 400 square miles and the law insists that it must be allowed to maintain a minimum flow of 20,000,000 gallons a day in pumping season. The excess of normal flowage in fall and spring, however, is large, sometimes in the spring floods the flow being as high as 150,000,000 gallons a day.

Hydro-Electric Light and Power for St. Louis, Mo.

The Union Electric Light & Power Co., of St. Louis, Mo., has filed with the Missouri State Public Service Commission a copy of its ninety-nine-year contract to use the electric current generated at the great dam across the Mississippi river at Keokuk, Iowa. This contract is made with the Electric Company of Missouri, with headquarters at Webster Groves, Mo., which in turn buys the current from the Mississippi River Power Co., which operates it.

The price to the Electric Company of Missouri is said to be about 4½ mills per kilowatt-hour for current delivered at Florissant, Mo., 130 miles from Keokuk.

The latter company carries the lines 10 miles to Wellston at the St. Louis city limits, and transforms it to meet the requirements of the city service. The

Union Electric Light & Power Co. agrees to pay $687,500 a year for not to exceed 294,771 kilowatt-hours in any one day. This price per kilowatt-hour computed from these figures is not quite 6½ mills a kilowatt-hour as a minimum. For current used in addition, additional price is paid.

An interesting feature of the contract is the provision for adjustment in five years and at ten-year intervals thereafter, the price to be increased at such times one-half of one per cent. for every cent increase in the price of coal per ton in the St. Louis market, so that the cost of electricity will advance as the cost of coal advances, and the increase in price will not depend upon the cost of producing and delivering the electric current.

Des Moines, Iowa, Loses Right to Buy Water Plant.

The city of Des Moines, Iowa, has lost its right to purchase the city works plant, according to an opinion handed down in federal court by Judge Van Valkenburgh. He denied an extension of time for the city to determine the legality of the election for the purchase, issuance of bonds and the like.

The city agreed to pay the water company $2,302,522 on December 3, 1914, for its plant. The city wanted the time extended to May 15, 1915. It is estimated that the city has spent $75,000 in its fight to buy the waterworks plant.

Water Company Offers to Sell to San Francisco

At a regular meeting of the supervisors on February 1 a commuuication was received from the Spring Valley Water Company offering to sell to the city its properties desired for supplying water to the municipality for the sum of $34,500,000. This offer is the same as that submitted to the advisory water committee and was in response to a resolution of the supervisors soliciting such offer and as required by the provisions of the charter. It is now in order for the supervisors to take further proceedings to submit the question of the purchase to the voters.

Improvements of Garrett, Ind.

The city of Garrett, Ind., has a population of about 5,000 and is making some notable improvements. In June, 1914, the new city hall was occupied. It is 50 feet wide and 125 feet long, two stories, with a high basement. The building is successfully heated with exhaust steam from the city water and electric light plant, which is 1,700 feet distant. The city had a municipal Christmas tree in the street in front of the city hall with a program prepared by the Garrett Municipal Yuletide Association, with a speech by the mayor, songs and distribution of gifts before and after.

In 1914 the expenditures for city purposes were practically $50,000, and the balance in the treasury was increased about $1,000. The city has $123,000 worth of property, including $34,500 for city hall and lot, $30,000 for water mains, hydrants, etc., $6,000 for steam heat pipe line, $8,500 for electric light plant, poles and lines, $3,500 for ornamental street lights, and many smaller items. The liabilities on this property are $8,000 water bonds, about $21,000 on city hall accounts and a few small items, making a total of $31,137.12.

In 1915 it is proposed to construct a trunk sewer to the city drain at a cost of $8,000; to install a new engine and accessories in the water and light plant, costing $5,500; to spend $500 in rebuilding electric light lines in the eastern part of the city, and to spend $2,000 in decorating and placing some tile and terrazzo floors in the city hall. The sewer cost will be assessed on the property benefited.

The water and light plant did a total business of $23,789.87, as shown by the clerk's collections. The number of electric current consumers increased from 715 to 790 and of water consumers from 815 to 850. The expenditures were $21,186.53, of which $1,061.94 was spent for additions to water lines, so that the profit on operations for the year was $3,789.01, not including $3,757.84 received from taxes, which may represent the city's share of the cost of operating the plant, so that the total gross profit of the plant was $7,546.85. This would pay, say 10 per cent. interest and sinking fund charges on a plant cost of $75,000, which is at least 40 per cent. more than the valuation of all parts of the plant in the schedule of the city's assets. The plant actually paid the city $3,000, besides making the investment of about $1,000 in new construction, and still has a balance in its treasury of $3,209.63 as against an overdraft the year before of $151.55.

The plant may, therefore, be classed among the successful plants and is justified by its balance and the increase in its business in making the proposed enlargements.

Greatest Drainage Pumps in Operation in Louisiana

On Saturday, February 13, the greatest drainage pumps in the world were started at New Orleans, La., signifying the beginning of a new era in North American conservation and a definite step in the plan of the State of Louisiana to bring into use some 10,000,000 acres of alluvial lands for the purposes of agriculture. They discharge 1,000,000 gallons of water a minute, and in three days' time completely drain an area of 40,000 acres. New Orleans lies on both banks of the Mississippi river. This land is situated on the great peninsula formed by the curvature of the Mississippi, and part of it is the city of New Orleans itself, the remainder being in the parishes of Jefferson and Plaquemine. These are part of the 10,000,000 acres of Louisiana lands which are being reclaimed by the simple process of pumping.

Holland, after seventy-five years of labor and expenditure of $3,200,000, drained 40,000 acres. Construction of the drainage plant opposite New Orleans has been under way for less than a year. The total cost will be $234,000, and it will require only three days to draw off the water and increase the value of land from $100 per acre to a minimum of $300 per acre. Coincidentally, the mosquitoes will perish and human health and comfort will increase.

This work, comparable in its potentiality to the digging of the Panama canal, is the work of one man, George A. Hero, a wealthy citizen of New Orleans, who placed his name and credit behind the task.

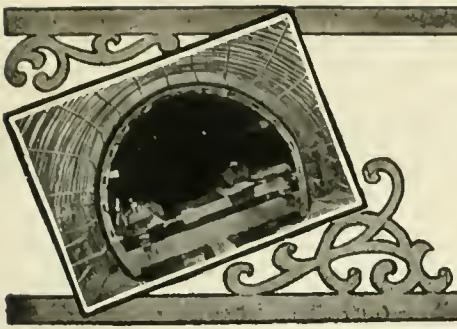
Under intelligent laws, framed for such purposes, a drainage district was created and the land-owners voted a tax against themselves of 75 cents an acre a year for forty years. Drainage bonds, backed by the credit of the State of Louisiana, and further backed by the privilege on the land itself, were issued and disposed of at once.

Other intelligent laws were enacted to aid this and other economic projects in Louisiana. Money invested in land mortgages is free from taxation, also is money on hand, in banks or homestead associations. To-day these fundamental laws of Louisiana have prepared the way for great economic changes. One of these is the huge new cotton warehouse system, owned by the public. This is part of the dock and wharf system, which is likewise owned by the public. This great warehouse system will have facilities for accommodating and handling 4,000,000 bales of cotton, or practically one-third of the entire crop of the South.

San Diego Exposition's Model Farm

The accompanying photograph shows a part of the model farm which forms a part of the Panama-California exhibition at San Diego. The five-acre tract contains trees which bear peach and apricot and loquat and walnut and cherry and pear, and beneath the boughs are a thousand rows of vegetables, filling every foot of soil and leaving no space wasted; the whole surface is irrigated and farmed scientifically, and the tract under such treatment is bearing more than an area four or five times as large under old-style treatment. There is a small poultry ranch at the rear, a little vineyard, a berry patch. In the center of the farm is a model bungalow, at which the wife of the prospective farmer may look, and see that, while machinery is saving her husband the drudgery of the farmer's life of three or four decades ago, so machinery is saving her the drudgery which was the lot of that earlier farmer's wife. She will see that in leaving the city apartment she is not abandoning modern comforts.

We are indebted to the Seagrave Company, who furnish the fire protection for the exposition, for the photograph, which is copyrighted by the exposition company.



SANITATION

Sewage Disposal at Lethbridge, Alberta

The new sewage treatment plant at Lethbridge, Alberta, is described in a paper before the Canadian Society of Civil Engineers, by A. C. D. Blanchard, who was city engineer at the time the plant was built, on plans of T. Aird Murray, consulting engineer, which were somewhat modified by Mr. Blanchard. The following notes are taken from this paper:

The city of Lethbridge is situated on a level plateau about 250 feet above the Belly river. Its first waterworks system was built in 1904. At the present time the population is about 12,000. With the extension of sanitary sewers the volume of sewage is rapidly increasing. The water pumped averages 1,300,000 gallons per day, and the waste returned to the disposal works is in the vicinity of 1,000,000 gallons per day. The city has a separate sewerage system, and three converging outlets bring all the sewage to the site of the works by gravity.

In the design of the sedimentation tanks there was sufficient novelty to evoke considerable discussion at the meeting of the Dominion Health Commission in Montreal in 1911, and as a consequence, some details of the design were altered, but the general type remained the same. The particular type of tank installed has been known as the "Lethbridge" tank. There is nothing unusual in the design of other parts of the plant, which is intended to treat the sewage of the city by preliminary screening, sedimentation, sprinkling filters and a further passage thru small sedimentation tanks. The liquid thus purified is passed thru a narrow baffle-race where chlorine solution may be applied.

The detritus tanks which contain the screens are in duplicate and have hopper bottoms, each equipped with a sludge valve. The screens do not reach to the bottom of the chambers. They are of ½-inch wrought iron with ½-inch openings. After passing thru the screens, the liquid passes over a weir into a collecting channel, and is then distributed thru two 18-inch pipes controlled by penstocks into the distributing channels of each sedimentation tank. The sludge or detritus in the compartment of the detritus chambers is intended to be disposed of thru sludge pipes discharged by gravity into one of the sludge beds. Each detritus tank, in volume, contains 675 cubic feet. The liquid surface area is 120 square feet and the area of the screen, including openings, is 52 square feet.

The sedimentation tanks are in duplicate. They are covered with a concrete roof 6 inches thick, supported by 24-inch I-beams, excepting over channels, which are covered with removable creosoted planks. Thruout the length of each are two distributing weirs. The one first reached by the liquid is on a slope of about 2 inches in the length of 100 feet, and the second weir is level. This latter weir is intended to equalize the flow so that the velocity of the liquid across any portion of the tank will be uniform, thereby causing the minimum of disturbance during settlement. Before reaching the collecting weir, the sewage is baffled by a 6-inch concrete wall with 4-inch holes near the bottom of it at intervals of 3 feet. The liquid passes thru these apertures into the collecting channel over the weir. This channel averages 15 inches in depth, there being a bottom slope of 6 inches from end to end. The particles capable of settling during the period of flow in the tank are deposited on slopes of wire glass, and when they have accumulated in sufficient mass the solids slide down the slopes and under the glass apron into the sludge compartment. This apron is a distinctive feature of the Lethbridge tank, and consists of ¼-inch wire glass laid on 4-inch I-beams spaced 5 feet on centers. The apron has a slope of 1 foot in 3.3 feet, and completely covers the sludge chamber. The corresponding fore-slope at the collecting side of the tank is formed in concrete on solid foundations, in which the wire glass is imbedded to form a smooth surface. The

slope of this portion is the same as that of the apron. Each tank is one hundred feet long and thirty-two feet wide. The period of flow for maximum capacity is practically two and one-half hours, and the maximum average velocity of flow is at a rate of .037 foot per second. The total contents and measurements of the various compartments are as follows:

(a) Total capacity.....34,000 cu. ft.
(b) Sludge capacity.....10,133 cu. ft.
(c) Capacity above apron..16,475 cu. ft.
(d) Capacity between sludge line and apron ..... 8,000 cu. ft.
(e) Liquid surface area... 3,200 cu. ft.

Note.—Sludge capacity is taken up to toe of fore-slope.

The capacity of the sludge compartments of both tanks amounts to 20,266 cubic feet. Storage is provided for a period of three and one-half months, based on a separation of 3½ cubic yards of liquid sludge to each million gallons of sewage. Each compartment has four hopper-shaped bottoms, a separate sludge valve being provided at the junction of the four slopes in each bottom. Two slopes of each hopper have a pitch of one in three, these variations being caused on account of the fact that the hoppers are not square. The top of the sludge compartment is, of course, formed by the glass apron previously mentioned, and this apron has sufficient pitch to allow gases which collect on the under side to pass to the extreme upper part of the apron, from which they are removed thru small galvanized iron pipes. In addition there are two 9-inch vitrified pipes at the ends of each tank which also serve as outlets. The sludge valves open on a 6-inch cast iron pipe line running lengthwise with each tank, and after these pipes are carried beyond the wall of the tanks they meet a 9-inch pipe line leading from the detritus tank sludge chamber directly to the sludge beds. The stems operating the sludge valve extend thru the glass apron to the roof and are exposed for use by removing small cast iron covers set in the concrete roof. One-inch water services direct from the city force main are connected to the end of each line of sludge pipes for the purpose of flushing, if desired.

The collecting channel between the sedimentation tanks discharges into a cast iron pipe with a bellmouth on a level with the bottom of the channel. The sewage in entering this bellmouth is subjected to a natural vortex motion for the purpose of giving the liquid a chance to draw down and absorb all the oxygen possible. This pipe, which is 21 inches in diameter, discharges into a distributing chamber in which are located the three controlling valves for each of the three filter units. The liquid passes thru to either of the filters by means of 12-inch cast iron pipes laid along the bottom of the filter floors to the riser pipes at the centers of the filters. The filter apparatus is of the standard rotating "Cresset" type. The sprinkling arms cover a circle, having a diameter of 108 feet, and are probably the largest yet installed in this country.

The filters are three in number with concrete floors and have their surfaces exposed to the weather. They are placed in juxtaposition so that the circular walls surrounding them do not meet at the point of contact of each filter. The walls are of concrete, and the filters are built on the natural soil, except at one place, where it was found that the ground was not sufficiently high to carry the floor. At this point the outside walls were carried down to the proper foundation, and the space between the ground level and the under side of the concrete floor was filled with gravel, the maximum fill being in the vicinity of 2 feet. The medium is composed of a mixture of broken brick, hard furnace slag and gravel, the average diameter of the particles being about 2½ to 3 inches. Near the bottom of the filters the slag was put in, in large pieces to protect the 4-inch collecting pipes of vitrified and field tile, which have ¼-inch open joints, and also to permit the quick flow of the liquid along the bottom. The central arm or standard carrying the revolving arms was surrounded by a pigeonholed brick wall, about 4 feet away from the drum. This construction was not only for the purpose of inspecting the machinery, but also to provide ample aeration for the filter beds themselves. The slope of the floor is 6 inches in a distance of 54 feet. The total medium area of all three filters is 0.62 acre, the average depth of medium, 7′ 0″, and the minimum capacity of the sprinklers is one-fifth of maximum, or 133,300 gallons to each distributer.

The humus tanks, for the purpose of obtaining further settling of the partially purified liquid after passing thru the filters, are constructed in duplicate, and are built adjacent to the filters, and at a depth sufficient to provide a good fall from the central collecting channel of each filter to the distributing channels of the tanks. They have each a capacity of 4,120 cubic feet. The bottom slopes of these tanks are drained to one central sludge valve, and in order to clean out one of these tanks it is necessary to decant the liquid and drain off humus from the bottom with the aid of flushing. These tanks are likewise constructed of concrete and are provided with a roof of concrete reinforced with expanded metal and steel beams in the same manner as the sedimentation tanks. The liquid is

drawn off from the tanks into the collecting channel over weirs 12 inches wide, and it then passes into a baffle race at the upper end of which is inset a pipe leading to the float chamber in the chlorinating house. There is also to be installed a small pipe carrying the hypochlorite solution.

Measurements of each humus tank are as follows:

(a) Capacity	4,120 cu. ft.
(b) Liquid surface area	1,200 sq. ft.
(c) Length of influent and effluent weirs	80 ft.
(d) Distance apart of influent and effluent weirs.	15 ft.
(e) Difference in elevation of influent and effluent weirs	.1 ft.

The design of the chlorinating plant is so arranged that there is an automatic regulation of the flow of chlorine solution into the liquid. This is done by the rise and fall of the float in the float chamber, which operates a lever, which in turn regulates the supply. Thus, if the volume of liquid coming thru the humus tank is increased, the level rises in the baffle-race, causing a consequent increase of chlorine solution to be applied. The baffle-race is only intended to give a thoro mixing of the chlorine solution before the liquid is discharged into the main outfall sewer, which carries the finally purified effluent to the river at a distance of about 1,000 feet.

The sludge beds are in duplicate and are simply rectangular excavations in the soil. It was not found necessary when the plant was constructed to do anything towards putting in a gravel or broken stone bottom to these beds, as there are strata of gravel in the excavation which carried away moisture from the deposited sludge in a most effectual manner. This was taken advantage of in the construction of the sludge beds. A narrow roadway at the end of each bed gives access for carts for removing the dried humus. Each bed has a surface area of 480 square feet.

Operation of the plant was commenced in the month of October, 1912, and the apparatus was given a fair trial before heavy frosts set in. Some difficulty was encountered in obtaining a proper seal in the drums of the rotating filters, and it required a considerable length of time to find out the exact cause of the defect. After careful examination it was found that the upper portion of the drum had developed a very small leak which allowed the air gradually to escape, with an ultimate loss of the seal. This was easily repaired and continuous running of the filter units was then possible.

After a month or two, however, it was noticed that a very considerable amount of colloidal matter was accumulating in the revolving arms of the filters, and it was found necessary to employ a man for a large portion of the day to keep the small holes in the filter arms from choking. After several endeavors to find the cause of this trouble, it was observed that when the accumulation in the detritus tank increased the accumulation in the filter arms became more objectionable. Since no adequate means were provided for removing the detritus from the bottom of the tanks, it was decided to flush the accumulating sludge out into one of the sludge beds. This process was then adopted at regular intervals. It appeared, however, that if the detritus tanks were sufficiently shallow to cause practically all the matter which would not pass thru the screens to go over into the sedimentation tanks and there be deposited as sludge, the liquid reaching the tanks would be more uniform in consistency, and the process of treatment improved. An alteration of the shape of the chambers was then considered, providing for the filling up of the lower portion of the detritus tanks with stone or gravel, and the building in of a concrete floor, the screens being sloped sufficiently to give the proper area for the capacity of the plant. By doing this it was hoped that the difficulty in connection with the clogging of the filter arms would be obviated, and the nuisance caused by the flushing of the fresh sludge into the sludge beds eliminated. The particular design adopted for the detritus chamber was felt to be the most troublesome feature of the plant.

After the plant had been operating for a month or two, severe frosts were experienced, which caused considerable ice to form on the top of the exposed filter beds, and on one occasion, after a snow fall of some 6 or 8 inches, one of the filters was started up with the expectation that the warm sewage would melt the snow. Unfortunately, however, the weather suddenly became colder, and instead of the snow disappearing, it was changed into ice, and it was found impossible to get rid of this accumulation until it was removed entirely from the filters. This was the only time that there was any trouble with the revolving arms on account of the accumulations, and it should never recur, as the operator has had the benefit of past experience. Thruout the winter months ice appeared on the surface of the filter beds during cold weather, and gradually built up into circular ridges between which were narrow openings, these openings, of course, appearing directly in the line of spray from the filter arms. No attempt was made to measure the efficiency of the beds under such conditions,

but it is hoped that a proper laboratory will soon be installed with a chemist in charge, and analyses made of the effluent not only from the filters, but also after passing thru all stages of purification. After running the plant thruout the winter months, it was found possible to obtain continuous operation of the filters with their machinery and surfaces exposed to the weather. In the following summer it was established that the fly nuisance was not a serious factor in so isolated a position. The construction of costly roofs over the filter units was therefore abandoned, altho provision had been made in the design of the filter machinery for the support of roof trusses from the central posts.

The filters are all thrown into use by the opening of penstocks by hand, which would appear to be a better arrangement than automatic control, for the reason that the winter conditions are sufficiently severe to cause freezing in the drums of filters which might be thrown out of commission for any length of time unless these were drained. Every time a filter is shut down, therefore, the operator proceeds to drain out the drum forming the air seal.

The difference in level between the surface of the liquid in the sedimentation tanks and the top of the riser at the center of each filter gave considerable trouble when a large volume of sewage was delivered to the plant. There was a noticeable surge in the distributing chamber at the entrance to the filters, and frequently the top of the riser would overflow, thus discharging unfiltered sewage into the humus tanks. It was deemed advisable to make an overflow from the distributing chamber, and this was accomplished by cutting thru one of the walls of the chamber and inserting a 12-inch pipe delivering into a trough laid on the top of the filter medium between filters Nos. 1 and 2 at a place not reached by the distributing arms. This arrangement seems to give satisfaction, and once or twice each day there is a surge which is efficiently taken care of in this way.

Garbage Disposal for North Yakima.

The health officer of North Yakima, Wash., Thomas Tetreau, recently made a report on garbage disposal by the sanitary fill system which follows. The city has some 2,000 loads of garbage a month to dispose of and about one-third the quantity of ashes:

The constant burning of garbage at the dump gives rise to many complaints from persons who are seriously inconvenienced by the decidedly unpleasant odors to which this burning gives rise. It has, therefore, been decided to try the "sanitary fill" system. The so-called sanitary fill was first tried in Seattle during 1913, and has been found there to be a most satisfactory and economical method of garbage disposal. Waste products of all kinds, including table refuse and other household waste, such as old clothing, mattresses, shoes, rubbers, bottles, tin cans, etc., are thoroly mixed and deposited in low, damp places, in layers approximately three feet deep; if desirable, these deposits may then be covered by a few inches of gravel, crushed rock, cinders, clinkers, or like coarse material. It is found that in these deposits all organic matter is rapidly oxidized without giving rise to any noxious odors.

Oxidation of tin cans and other metal wastes also takes place, tho considerably more slowly than does the oxidation of organic, particularly vegetable, waste. The oxidation is found to be due in part to the direct action of bacteria upon organic matters, which action is greatly facilitated by the porous nature of the deposit, which permits of the absorption of moisture and the escape of the gases formed during the process of decay.

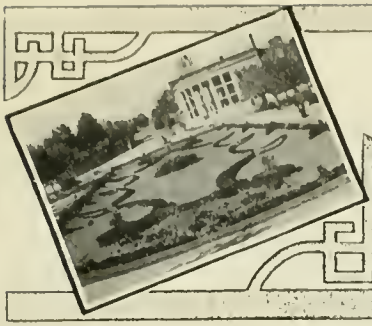
There can be no objection to this method of garbage disposal during the winter months, altho in the summer time it might become necessary to use some insecticide or larvacide, should the dump be found to attract flies.

Your health officer was much impressed with the success of this form of garbage disposal in Seattle, where he recently visited several such fills. Should it be found practical for all seasons in this climate it would probably for a long time do away with the necessity of constructing an incinerator and prove a considerable saving to the city.

Combined Street Sprinkler and Sweeper

Ed. Smith, street commissioner of Huntington, Ind., has just completed a new sprinkler which will be used in combination with the street sweeper wagon. Formerly a sprinkling wagon and a sweeper wagon were both used on the streets. The new arrangement does away with one wagon, team and man, amounting to $4 a day, besides the amount of water saved, at least one-third of the water generally used.

A large tank, which holds 370 gallons of water, was placed on the sweeper. The tank is made of 20-gage galvanized iron. The sweeper lever is placed on one side of the wagon to allow the sprinkler pipe from the tank to be installed. The pipe is placed just back of the front wheels of the wagon. This gives the water about five feet space ahead of the sweeper.



Municipal Notes

Traffic Regulation by Zones Marked on Pavements

The regulation of street traffic has been greatly aided in a number of American cities by the use of marked zones upon the pavements. One detail alone has obstructed the wider and more satisfactory use of the system. Paving brick offers the solution to this perplexing detail.

In both Detroit and Dayton this method of regulating street traffic has proved very successful.

No satisfactory method for marking zones has yet been developed among the police officials who have experimented with the zone idea. They have searched arduously for a white paint durable enough to stand a reasonable amount of street wear when applied to the surface of a pavement. Constant repainting of the pavements at considerable expense has been an accompaniment of traffic zone experiments wherever tried.

The use of anything so impermanent as paint on the surface of a public highway, of course, manifests the experimental nature of the present traffic zone era. When such means of regulating traffic have become standarized and wholly accepted, permanent markings will be needed.

Brick paving offers the best possible medium for such permanent marking. By laying lines of light brick against a dark brick background, or vice versa, lines can be established which will be visible for half a century if left alone, or can be altered at trifling cost to conform with changes in regulations.

The object of the traffic zone system, so far, has been to keep the different currents of street traffic apart, particularly to indicate spaces within which the right and safety of the pedestrian must be respected. Street crossings are outlined with a 10-foot margin back of which vehicles must remain until signalled to proceed by the traffic officer.

Zones are also marked at points in the street where pedestrians enter and leave cars. The lines here inclose a space perhaps 10 by 30 feet in area parallel to the car tracks. Within this space the passenger can wait for the approaching car with a feeling of security that is impossible when the auto driver is not accustomed, by some visible sign, to steer clear of such spaces.

The problem of auto storage in business centers offers another function for marking. Detroit has set aside a portion of a wide downtown plaza as a place for the parking of vehicles. Markings keep the machines in a straight line and indicate how much space each vehicle may use.

St. Louis has made attempts on several streets to establish an exclusive, one-way traffic compensated by a return traffic on a parallel street. This leaves one side of the street for parking vehicles, spaces being marked at right angles to the curb.

In the same city there is attempt to divide auto traffic at street intersections, so that vehicles turning to the right will keep to the curb, while those going forward or to the left will steer near the center line of the street.

The time is probably at hand when travelers at congested crossings will find their way plainly indicated for them by traffic markings. The mosaic effects possible with varying shades of brick offer a method of marking that should be wholly satisfactory.

Improvements in Arkansas City

During 1914 the city of Arkansas City, Kan., laid 6,663 linear feet of concrete sidewalk, 4,665 feet of curb, and 2,200 feet of curb and gutter, also 19,537 square yards of paving. A handsome concrete bridge, costing $24,000, across the Arkansas river northwest of the city, is practically completed.

The city now has 23 blocks of asphalt pavement, 8.5 miles of water bound macadam, 6 blocks of brick, 1 block of concrete and 41 miles of sidewalks. The water system has 30 miles of mains and 243 hydrants. Rates are 10 to 25 cents per 1,000 gallons.

A Profitable Light and Water Plant

The Water, Electric, Gas and Power Commissioners of Austin, Minn., operate a combined electric light and power and water supply plant which seems to be financially successful as shown by the annual statements which are clear and full as is now required by State Public Service Commissions.

The value of the plant is given by subtracting from the valuation at the end of the preceding year depreciation of 5 per cent. and adding the improvemnets of the year. In the last fiscal year this value increased about $13,000 and is $256,115.25.

Including stock, $14,980 of cash and loan of $4,000 to the city, the total assets are $281,699.34, against which are $30,000 of water works bonds outstanding.

During the year the gross receipts were $69,235.91. Operating expenses amounted to $31,727.66, leaving a comfortable balance after ample allowances are made for interest, taxes and depreciation or sinking fund. The interest and taxes actually paid amounted to $2,138.06.

The business is growing, as shown by a net increase in light users of 201, making 1,408; power users of 3 making 66, and 154 water users, making 1,236. Uncollected accounts amounted to only $95.39.

Proper Terms for Highway Bonds

The United States Office of Public Roads has made some studies of the durability of various parts of a highway as a basis of opinion upon the propriety of bonding the state, county or township and upon the terms for which the bonds should be issued. These studies covered 244 roads of gravel, waterbound macadam and bituminous macadam.

For some reason the gravel road is assumed to be 20 feet wide, tho it is more common, especially where gravel is used as the material for the cheaper roads, to make the graveled surface as narrow as the traffic will stand, and the width is usually not greater than 12 feet, and is probably nearer 10 feet. Sometimes the grading is as wide as 20 feet, but even this width is usually not more than 14 to 16 feet. The cost of gravel roads, given as $4,416, is therefore greater than the actual cost, and $2,208 is probably nearer the usual average cost. Probably the proportionate costs of the more or less permanent drainage and grading, 41.15 per cent. of the total cost, and of the quite temporary surfacing, 58.85 per cent., are about the same for the 10-foot width as for the 20-foot width given in the report referred to. The 59 per cent. represented by the gravel can hardly be the basis of a bond issue of more than 5 years' term unless the road is one of very little travel. Probably most of the 41 per cent. for drainage and grading is permanent enough to warrant the issue of 20-year bonds, tho ditches and often bridges and culverts are not built with this degree of permanency, and often not more than 20 per cent. can be considered as having a life of 20 years or more, the remainder averaging perhaps 10 years' life.

The ordinary waterbound macadam is assumed in the report to be 15 feet wide, again somewhat wide except for the modern high-class roads built by state highway commissions. The average cost is given as $9,215, of which 36.89 per cent. covers the cost of the more permanent portions, drainage and grading, and 63.11 per cent. the less permanent surfacing.

For bituminous macadam 15 feet wide the report gives $10,298 as the cost, of which 26.85 per cent. is the proportion expended in grading and drainage and 73.15 per cent. that of the surfacing.

The actual cost of grading and drainage, computed from the above figures, is $3,399 for waterbound macadam and $2,765 for bituminous macadam. As there is no reason for the latter cost being less than the former if the roads are fully constructed, it is probable that this difference arises because the bituminous macadam road is usually a reconstructed macadam or gravel road, on which much of the drainage and grading has been done prior to the construction of the bituminous macadam road. The same seems to be true also of the drainage and grading of the macadam road as compared with the gravel road.

Only a very small percentage of the cost of the kinds of roads above considered can be used as the basis of 50-year bonds; less than 40 per cent., probably as little as 25 per cent., can be used as the basis of 20-year bonds, and the remainder, 60 per cent. or more, could not be used as an ordinary business basis for more than 5-year bonds, and the amount should be divided into equal parts of 1, 2, 3, 4 and 5 year bonds if they are to represent any actual material on the ground.

If the roads are well taken care of and the material worn off is replaced each year as a maintenance charge, there may be some argument for longer term bonds for the portion of the cost representing the wearing surface, but a reconstruction of the surface must be made within 5 to 10 years if the traffic is appreciable, and the portion of the bonds representing the surface should not have life enough to last over the time for reconstruction.

Otherwise the road will not be paid for before it is worn out and the taxpayer will be paying for two roads at the same time covering the same area.

Advertising Newark

The city of Newark, N. J., has been constructing a system of municipal locks and now has in their vicinity factory sites bordering the best equipped water-rail terminal on the Atlantic coast, according to the attractive circulars of the Department of Docks and Meadows, which show the advantageous location of the docks and the factory sites for direct service to factories and to railroads. Newark is styled the new Atlantic seaport. The department will give full information at its office in the Newark city hall.

San Francisco's First Municipal Tunnel

The Stockton street tunnel has been completed, accepted and was dedicated to the use of the public by appropriate ceremonies late in December. The cars of the Municipal Railway commenced operating thru the tunnel on December 29.

The project for a tunnel in Stockton street from Bush to Sacramento streets was first broached shortly after the fire, and a franchise was granted in 1907 to a private corporation to construct a street railway thru the hill from Market street to the North Beach waterfront. The project proved too great for private financing and the franchise was abandoned in favor of a municipal undertaking.

A large amount of preliminary work had to be done before a start could be made. The charter was amended in 1910 so that the city could have legal authority to undertake the project, and following the adoption of the amendment an ordinance had to be prepared so that the procedure would be adequate for its successful financing. The method called for an assessment of the entire cost upon an assessment district which would be benefited by the proposed construction. There were no precedents for such work in the state, and an original scheme had to be worked out in its minutest detail. The "Tunnel Procedure Ordinance" was framed and adopted in September, 1911, and the engineering department immediately took up the practical part of the work.

The report of the engineer, showing the assessment district, the plans and specifications, and the amount of individual assessments, was filed April 19, 1912. The estimated cost, including possible damages and incidentals, was $631,879. This amount was assessed against 1,443 parcels of lands extending from the south side of Market street to the bay shore on the north. A year was spent in public hearings and in making minor corrections in the details. An action at law, involving the legality of the proceedings, was commenced and resulted in establishing the validity of all that had thus far been done. Damage claims had been settled amounting to nearly $200,000, and bids for construction were received in April, 1913. Actual construction commenced in the month following.

The Stockton street tunnel, as constructed, has the widest arch span of any long tunnel yet designed. It opens a direct line for street car and vehicular traffic between the downtown district and the Panama-Pacific Exposition grounds, and will greatly aid the rapid development of the North Beach territory.

The following data concerning the tunnel are furnished by the city engineer:

Tunnel extends from Bush street to point 182 feet south of the center line of Stockton street.

Length, portal to portal, feet	911
Length of north approach, feet	138
Length of south approach, feet	275
Total length, including aproaches	1,324
Height of arch above curb, feet	18
Width, feet	50
Thickness of base, feet	8
Thickness of roof	2 ft. 8 in.
Cubic yards excavation	143,000
Cubic yards concrete	16,500
Pounds of steel	637,000
Price	$430,000.00
Damages	$191,000.00

Connection of Rival Local and Toll Telephones Required

The Railroad Commission of Wisconsin requires physical connection of telephone exchanges so that local and long distance calls on one system can be made on subscribers on the other system. The Rock County and Wisconsin Telephone companies in Janesville were recently required to make such physical connections between their toll lines and between their local systems in Janesville, including rural service, the expense to be paid equally by the two companies.

Portland Cement in 1914

For the first time since the manufacture of portland cement became a real business proposition in this country there has been a less production in a year than in the year before, the production in 1914 being 88,514,000 barrels, as compared with 92,097,131 barrels in 1913, a reduction of nearly 4 per cent. The production of iron ore in 1914 was about 33 per cent. less than in 1913.

MISCELLANEOUS

Bearing Value of Soils

The American Society of Civil Engineers has appointed a special committee to codify the present practice on the bearing value of soils for foundations and to report upon the physical characteristics of soils in their relations to engineering structures. The committee has prepared three sets of questions asking (1) for results of tests for bearing value of soils, (2) for data as to the bearing value of soils from existing structures, and (3) for local practice as to the bearing value of soils. Answers to any or all of these series of questions are requested from every one having information concerning them. The lists of questions will be sent to any one willing to answer any of them, by Robert A. Cummings, chairman of the committee, 221 Fourth avenue, Pittsburg, Pa.

Criticism of Engineers

The Western Society of Engineers, of Chicago, has been aroused by the unfair discussion of the report on water power development of the sanitary district made by L. E. Cooley, John Ericson, L. K. Sherman and Wm. Artingstall, and the personal abuse of these men in connection therewith by some members of the sanitary district board and of the city council and by the daily papers, and expresses its opinions in a series of resolutions, from which the following sentences are taken:

While the constitution of the Western Society of Engineers provides that the society "shall neither indorse nor recommend any individual or any scientific or engineering production," it does provide that the opinion of the society may be expressed on "such subjects as affect the public welfare," and it is the desire of the society, by this resolution, to point out that the public welfare is vitally affected by any pronounced attempt on the part of public officials to suppress, conceal, distort or overawe tbe carefully prepared opinions of experienced engineers reporting on public questions for the public interest.

This society views with regret this public attempt to abuse men who were apparently trying to do their duty to the public in setting forth facts as they found them and testifying to the truth as they saw it, and the society would point out, for the benefit of the public officials who have been conspicuous in this controversy, the following proper relations with engineering advisers, which it wishes to emphasize at this time, as a matter which vitally affects the public welfare:

First—That an engineer's first duty to his client is to tell him the truth, no matter where it may lead or how unpalatable it may be.

Second—That engineering and engineering economics are subject to natural law, which cannot be altered to suit the whims of human nature.

Third—that the most serious disgrace that comes to an engineer is to conceal, pervert or distort natural and economic law, either to please a client or temporarily advance his own interests, and so ultimately lead his client into difficulties.

Fourth—That an experienced engineer of standing ranks as a confidential professional adviser, feeling keenly his responsibilities, and whose integrity and conscientiousness, when properly established, should be appreciated and upheld by his client.

Fifth—That engineers, while not infallible or superhuman, are more apt than laymen to be right in their findings on engineering facts and economic truth connected with engineering matters.

International Engineering Congress

The technical success of the International Engineering Congress is now well assured. Notwithstanding the difficulties arising as a result of the present European war, the committee on papers is able to count on from 200 to 250 papers and reports covering all phases of engineering work and contributed by authors representing some eighteen different

countries. The congress will therefore be truly international in scope and character, altho the representation from the countries involved in the European war will naturally be less than originally planned.

The papers are now rapidly coming in and their character gives the fullest assurance that the proceedings will form a most important collection of engineering data and a broad and detailed review of the progress of engineering art during the past decade.

Membership in the congress with the privilege of purchasing any or all of the volumes of the proceedings, is open to all interested in engineering work. W. A. Cattell, secretary, 417 Foxcroft Building, San Francisco, Calif.

Technical Associations

The Illinois section of the American Water Works Association, until this year the Illinois Water Supply Association, holds its seventh annual meeting at the University of Illinois, March 9 to 11. A very full program has been arranged, covering construction and operation problems, filtration, artesian well water, regulation by public utility commissions and by-laws, accounting, waste prevention, etc.

The twenty-ninth convention of the National Brick Manufacturers' Association was held in Detroit, February 15 to 20. In connection with it the board of directors of the National Paving Brick Manufacturers' Association held a meeting and admitted three new members: the Harris Brick Co., Cincinnati, O.; Southern Fire Brick and Clay Co., Montezuma, Ind., and Standard Brick Co., Crawfordsville, Ind. The board spent "A Night of Good Roads" with "The Knights of Good Roads" at the Hotel Statler, on Tuesday, February 16 with a banquet, an illustrated lecture on "The Importance of Minor Details in the Construction of Brick Paved Highways," by Prof. F. N. Menefee, of the University of Michigan, and booster speeches on "Good Roads and How to Get Them," by Jesse Taylor, of *Better Roads*, and on "A Real Road for Real Estate," meaning the brick roads of Cuyahoga county, Ohio, by Stanley McMichael, secretary of the Real Estate Board of Cleveland.

The proceedings of the Federation of Trade Press Associations at its convention in Chicago, September 24 to 26, fill a book of 194 pages.

The American Proportional Representation League publishes a quarterly, *Proportional Representation Review*, at 5 cents a copy or 20 cents a year. C. G. Hoag, secretary, Haverford, Pa.

The twenty-fourth annual report of the New York Tax Reform Association, for 1914, has been issued by A. C. Pleydell, secretary, 29 Broadway, New York.

The Inventors' League of the United States, founded in 1912, has offices at 124 Maiden Lane, New York City. Charles A. Mullen is one of the vice presidents and Herman D. Sears is corresponding secretary.

An exposition of goods "Made in the U. S. A." will be held at the Grand Central Palace, New York, March 6 to 13.

At its meeting on February 11 the Brooklyn Engineers' Club heard a paper by Eric T. King on the 66-inch steel conduits for the Catskill water supply in Brooklyn.

The National Municipal League offers two prizes of $30 and $20 for the first and second best papers by high school pupils on fire prevention. Clinton Rogers Woodruff, North American Building, Philadelphia, Pa., secretary.

At its meeting on February 9 the Cleveland Engineering Society heard a paper by Prof. C. F. Hirshfield, of Detroit, on the Connors Creek plant of the Edison Illuminating Co.

The County Surveyors' Association of California has been organized, with Drury Butler, of Sacramento, as secretary.

The eighth Chicago Cement Show compared favorably with its predecessors. The expansion of and the great changes in the cement industry can be seen by comparing this exhibit with the first one held. As usual, several associations held conventions during the show, including the American Concrete Institute, the American Concrete Pipe Association, the National Builders' Supply Association, and the Illinois Lumber and Builders' Supply Dealers' Association.

The annual meeting of the American Road Builders' Association is not held at the annual convention, but at a later meeting, held this year on February 6, at the Hotel Astor, in New York. Geo. W. Tillson was elected president.

The annual meeting of the Minnesota Surveyors' and Engineers' Society was held in St. Paul, Minn., February 19 and 20. The program was quite well arranged, sessions being devoted to notes, records and costs; drainage problems; roads and bridges; sanitation, light and heat, with single papers on stadia surveying, explosives, and the League of Minnesota Municipalities. Geo. H. Herrold, secretary, City Hall, St. Paul, Minn.

The fire alarm system of New York City was described for the New York Electrical Society at its meeting, February 17, by Putnam A. Bates, electrical engineer of the department.

The eighth annual meeting of the Indiana Sanitary and Water Supply Association, held in Indianapolis, February 23 and 24, was one of the most successful

of its life. It had a full supply of papers and they were very valuable and gave rise to interesting discussions. Water waste, fire prevention, state control and some problems thereof, water works management, water rates and economies, devices and machinery, sanitary surveys, lawn care and water for it, typhoid fever, industrial wastes, stream pollution, sewage and water purification, destruction of algae in surface water, were well handled. Dr. J. N. Hurty, secretary of the State Board of Health, was elected president.

Civil Service Examinations

The U. S. Civil Service Commission will hold examinations at the usual places as follows:

April 6: Expert landscape architectural designer in office of Public Buildings and Grounds, Washington, D. C., at $200 a month.

April 7: Sub-inspector in Navy Yard, Washington, D. C., at $4.48 a day, and probably other positions at $3.60 to $5.04 a day; Assistant inspector of engineering material in office of Inspector of Engineering Material at Pittsburg, Pa., at $4.48 a day; landscape architectural draftsman in Engineer Department at Large, War Department, Washington, D. C., at $90 a month.

April 7-8: Electrical draftsman, radio, in Navy Yard, New York, N. Y., and elsewhere, at $3.52 to $5.52 a day.

Technical Schools

On February 12 George C. Warren delivered a lecture before the graduate students in highway engineering at Columbia University, on "Public Recognition of Patents and Specifications for Patented Pavements," which is issued in pamphlet form for general distribution.

Engineering Bulletin No. 4 of the University of Kansas, Lawrence, Kans., contains a statement of the organization and work of the engineering experiment station of the university, and a study of vocational education in the state, with the courses of study offered in the University School of Engineering.

The report of President Jacob Gould Sherman, of Cornell University, and the other officers of the organization, for 1913-14, has been issued.

A short course in highway engineering was held at the University of Michigan, February 15 to 20, by the Department of Engineering, in co-operation with the Michigan State Highway Department. Lectures by professors from Michigan, Georgia, Illinois, representatives of the State Highway Departments of Michigan and Iowa, Wayne county, and the U. S. Office of Public Roads, consulting engineers on road work, and others, covered the subjects of the split-log drag, continuous maintenance, earth roads, contract and day labor, specifications and contracts, bituminous materials, road service, road machinery, highway bridges, organization, duties of officials, county road plans, etc. Mornings were devoted to "class room work" on earth roads, stone and gravel roads, miscellaneous roads, surveys, plans and record drawings.

The extension division of the University of Wisconsin offers a series of ten lectures to Wisconsin motorists on the automobile, covering types of machines, gasoline engine, fuels and carburetors, battery ignition, magneto ignition, lubrication and cooling, self- starters, transmission, motor car troubles, driving, selecting a car.

Personal Notes

A. C. Comey, landscape architect, of Cambridge, has been retained by the city of Lawrence, Mass., to make a survey of the district along the Spicket river, to beautify and better the place.

John Nolen, of Cambridge, is at work on plans to beautify the campus and surroundings of Davidson College, at Davidson, N. C.

Edward M. Hagar has resigned his position as president of the Universal Portland Cement Co., one of the subsidiaries of the United States Steel Corporation, to develop a new company to acquire a chain of portland cement plants covering a large part of the United States.

C. D. Martin is the new city engineer of Merced, Cal.

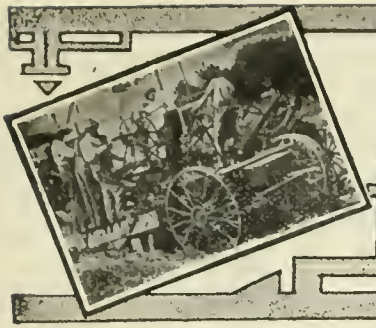
F. L. A. Gorlinski is city engineer of Willits, Cal.

Prof. Arthur H. Blanchard, M. Am. Soc. C. E., in charge of the graduate course in highway engineering at Columbia University, delivered addresses, February 9 and 11, before the Middletown Scientific Association and at the annual meeting of the Engineers' Society of Northeastern Pennsylvania.

Hering & Gregory, consulting engineers, of New York City, have been retained by the Board of Contract and Supply of Albany, N. Y., to prepare plans and specifications for an electrically operated sewage pumping station, to be built in connection with the sewage disposal works; capacity, 30,000,000 gallons daily.

Robert V. Orbison has succeeded the late Lewis E Smith as city engineer of Pasadena, Cal.

A. G. Wulf, C. E., has opened an office at 309 Provident Bank Building, Cincinnati, O., for the practice of civil engineering, making a specialty of sewerage and other municipal work.



MACHINERY AND SUPPLIES

Asphaltic Concrete on Riverside Drive, New York City

The Board of Estimate and Apportionment has unanimously approved the award of a contract for paving the northern section of Riverside drive, New York, with Bermudez asphaltic concrete. The bid for this construction was somewhat higher than the bid on oil asphalt. When the question originally came before the board some months ago Mayor Mitchel said that in the case of a pavement so important as that on Riverside drive the city was justified in giving a preference to and paying a higher price for a pavement that had proved that it would stand the traffic. The drive is now paved with Bermudez asphaltic concrete from 72d to 114th streets, laid by the Barber Asphalt Paving Company in 1913. The contract just awarded will complete the drive to the viaduct at 130th street, beyond Grant's tomb.

Solid Tire Care

Much is said about the care necessary to obtain good service from pneumatic tires, but there isn't much said about the care of solid tires, and as the truck industry develops this becomes a more and more important subject.

In fact one hears rather how truck tires don't need any watching. That probably accounts for a good deal of the tire trouble truck owners experience. It is true that, compared to pneumatic tires, solids need little care, but what care they do need is absolutely essential to full mileage.

By far the most important precaution is to see that the tires are not overloaded. And here is the reason. Everybody realizes that rubber, if stretched too far, will break. Very few people realize that rubber if compressed too tightly will break also. That is just what happens when too great a load is imposed on a truck tire. The tire is crushed between two unyielding surfaces, the road and the steel base of the tire. If the load is too great, the compression becomes too much and the molecular structure of the rubber is broken down.

Another point in connection with this matter of overloading that isn't generally understood is that one overloading will ruin a tire for good. Take a toy rubber balloon. Blow it up. It stretches and stretches, but at a certain point it breaks. And after that the baloon is no good. It can't be blown up again. The same is true with a truck tire, only in a different way. Put a solid tire on a truck and load the truck. The tire compresses and compresses up to a certain point and then breaks. Once it is broken it can't be used again with satisfactory results.

The best tire advice that we can give a truck owner, then, is, "Equip your trucks with tires adequate to carry the load you want to put on them, then give your driver hard and fast instructions that to that point he shall load the truck and no farther.

The Socket Joint Type of Fiber Conduit

In planning an underground conduit system, one of the most important points to be considered in selecting the material to be used is that which relates to the method of connecting one length of conduit to the next. The importance of this point lies in the fact that upon the method used depends the alinement of the completed system; the degree to which it may be made proof against water and gases and also the degree to which it will protect the cables from abrasions and cuts when drawn across the points. In addition, the methods of making the points increases or decreases the cost of installing the conduit, depending, of course, on the type of conduit material used.

The method pursued in joining clay conduit, unit to unit, is either to butt the ends of the conduit together, wrap the point with burlap and bind with cement mortar; or, connect the units by means of

dowel pins, then wrap with burlap and bind with cement mortar. These methods are the best that can be employed where a clay conduit is used, but from a mechanical standpoint they do not lend sufficient strength to the conduit structure, and any settling of the ground around the system will throw it out of alinement and will in all probability lock the cables firmly within the ducts, or will prevent the drawing-in of cables.

In the socket joint type of Orangeburg fibre conduit the male and female joints that are automatically turned on this type of conduit are so accurately cut that it is only necessary to push one within the other to secure absolute and permanent alinement and without the use of a coupling compound, form a practically water-tight and gas-proof connection. It is not necessary to use a mandrel to secure alinement, neither is it necessary to wrap each joint with burlap to keep the contract from seeping thru the joints to the interior of the duct.

While laying a system of Orangeburg fibre conduit, employing the socket joint type, construction forces have found that the installation of the material proceeds usually at twice the speed required to lay other types of conduit and oftentimes fibre conduct is laid even faster. For figures relative to handling, cartage, and laying of fibre conduit, see pages 34 to 40, inclusive.

Inspecting Fire Hazards

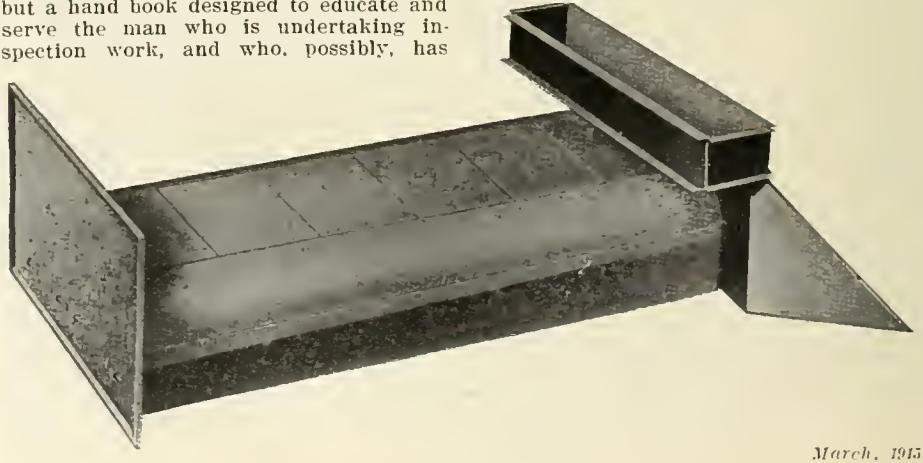
The committee on field practice of the National Fire Protection Asociation has completed its two years' work in the compilation of an inspection manual. This publication is called Field Practice, to distinguish it from an ordinary fire protection hand book, from which it differs radically in function. It is not a mere compilation of fire protection standards, but a hand book designed to educate and serve the man who is undertaking inspection work, and who, possibly, has had very little previous experience. The increasing inspection of premises by uniformed members of the fire departments and by newly constituted municipal inspection bureaus has made such a hand book imperative, covering not only standard equipments, but covering what may be called points of relaxation from the standard which the inexperienced inspector does not know how to look for. This book is designed to point out the common faults in equipment and those points of deterioration difficult for inexperienced persons to discover, with methods and suggestions for their remedy. It is, in its potential usefulness, the most important publication which the National Fire Protection Association has ever compiled.

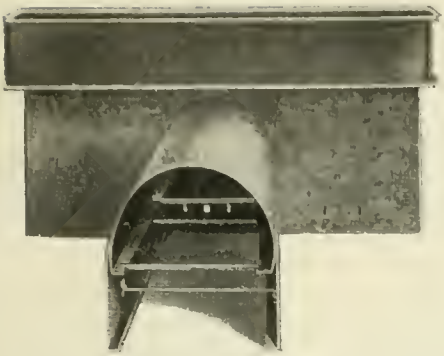
The association has published a list of its pamphlets, standards, bulletins, fire reports, etc., which will be sent on application to the secretary, 87 Milk street, Boston, Mass.

A Collapsible Culvert Form

A concrete form which is made in one size but will build culverts of spans varying from 15 inches to 5 or 6 feet with either arch, semi-arch or flat top, has been devised by E. J. Whalen, of Syracuse, N. Y., and is in very general use. It complies with the New York state standard plans and with many others.

WHALEN CULVERT FORMS, *set for flat top with quarter circle sections of arch at each side-wall. Note sections of arch form, of cover, and of side-wall plates. One end is supplied with form for end protection wall. The right end is supplied with forms for wing walls and parapet wall. All concrete is cast together into a monolithic structure.*





END VIEW *of form set for semi-circular culvert with end protection and parapet walls. Note method of collapsing form after concrete is set.*

The Whalen form consists of four sections with arch tops and is 24 inches wide, 27 inches high and 24 feet long. The form is equipped with two head walls, each 48 by 84 inches, one set of wing walls, one parapet box and six cover plates, each 2 by 3 feet. The arch top has a radius of about 12 inches.

To build culverts with spans greater than 24 inches, the quarter circles are set with cover plates joining them, thus giving arch forms at the quarters connected by the necessary length of flat top.

The larger of the accompanying photographs shows the method of assembling the parts of the form for this plan of construction. It also shows the placing of the wing walls and parapet box, making a complete protected culvert and parapet in one operation.

By making a complete 24-inch arch, a culvert of double the capacity of a 12-inch pipe can be made in which the amount of water filling the 12-inch pipe would flow only 4½ inches deep, and there would be 7½ inches of culvert height to take care of flood conditions.

The smaller photograph shows an end view of the form set to build a culvert with a semicircular arch top and vertical side walls. It gives a view also of the bracing which makes the form collapsible, so that when the concrete has set the form is certain to collapse when the or knock down the form without assistance. The metal in all the parts of the is very durable. E. J. Whalen is the inproper turns are made and it is then readily removable. One man can set up ventor, the Concrete Form Company are the manufacturers, and the Whalen Form, form is galvanized inside and out and Syracuse, N. Y., is the address which will bring full particulars to any inquirer.

A Fire Alarm System

A fire alarm system, designed expressly to meet the requirements of the Bureau of Fire Prevention and Public Safety of Chicago, has been developed by the American Telephone Fire Alarm Company, of that city, which has some points of great interest.

The fire alarm boxes are of the break-glass type, simple, non-interfering and positive in operation with a chained hammer with which to break the glass when alarm must be sent in. Each box transmits its own signal according to the code and when once started manipulation of the starting lever will not interfere with the transmission of the entire code of signals. After the code of signals has been transmitted a semaphore falls from its normal position and can not be restored until the box has been reset, rewould and the glass replaced. This semaphore indicates whether the box is in working order.

Any number of bells can be put in the circuit with the boxes and they will all indicate the location of the box operated, according to the signal code.

A control panel and batteries are located conveniently for the employe having charge of the system. This panel contains the testing devices and terminals for connection to the bells, boxes and battery. The circuit control consists of an energized electro-magnetic device, which keeps the circuit under constant test thru a 2½-milli-ampere discharge. When a fire-alarm box is operated, the circuit control is de-energized, allowing its armature, which is equipped with pure platinum contacts, to connect the main fire-alarm battery to the circuit. The code wheel of the fire-alarm box

FIRE ALARM BOX, *as installed ready for use, with glass plate front and hammer for breaking it to send in an alarm.*

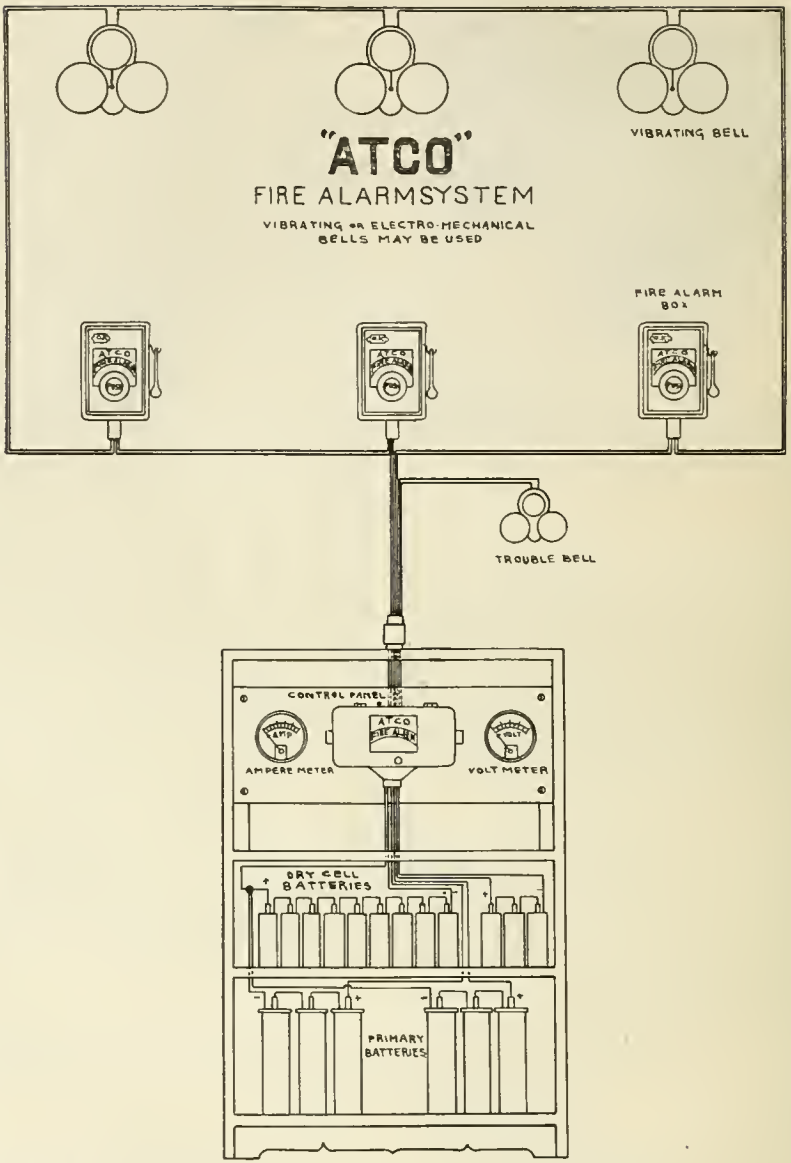


DIAGRAM OF CIRCUITS *and connections for system of American Telephone Fire Alarm Company and of the control panel for the same.*

closes and opens a circuit, causing the bells to strike as the mechanism of the fire-alarm box opens and closes the circuit with its code wheel.

All circuits are connected with the control panel and are so arranged that a break anywhere in the system, whether accidental or malicious, a drop in voltage, or a complete failure of battery will cause the instant operation of a trouble-alarm bell, which continues until the trouble is remedied. This keeps the circuits under constant test, a most valuable feature in a fire-alarm system.

The control panel also has a test lever which, when opened, causes one stroke on all the bells in all the circuits and a constant ring on the trouble bell. This gives a manual test of the whole system at will. A reset is provided in the controller cabinet which electrically resets the circuit controller.

THERMOPILE *for sending in a fire alarm automatically when the heat increasing rapidly indicates starting of a fire.*

A whole building or group of buildings is thus provided with a fire-alarm system, with as many boxes as may be necessary to enable prompt sending of fire alarms and as many bells as may be desired to give notice of the location of the box pulled. The constant test and the daily test are the important features of the system. The name for the plant is the Atco system, and it is made by the American Telephone Fire Alarm Company, 10 South LaSalle street, Chicago, Ill.

The company has combined the Denio system, operating over a telephone circuit as described above, with the Reichel automatic fire alarm, which simply adds a series of thermopiles, which are made of dissimilar metals, thru which a current of electricity passes. This current is generated by the application of heat to the exposed ends of the couples of dissimilar metals, the ends enclosed in the porcelain holders remaining at normal temperature. This current operates a galvanometer, which moves under it into a contact which operates the fire-alarm box.

Ordinary slow changes of temperature do not make sufficient difference in temperature to produce the current necessary to move the galvanometer needle into contact. Sudden heating of the exposed ends of the thermopile, such as would be done by a fire, producing a difference of temperature of some 10 degrees within 60 seconds, between the exposed and enclosed ends of the thermopile causes current enough to operate the galvanometer needle and set off the fire-alarm box. The action depends not on actual temperatures but upon the rate of change of temperature, so that the thermopile will act at any actual temperature provided the rate of change is as above stated, and may set off the alarm in less than the 60 seconds.

A Speed Lathe Valuable for Municipal Repair Shops

Particular attention is called to the new book just issued by Leiman Bros., 62 John street, New York, illustrating and describing their bench speed lathe.

This machine should be found in every tool room, jewelry and novelty shop or any sort of an experimental or machine shop, laboratory, training school, or home workshop. The machine is very accurately made, having dust-proof bearings and hollow spindle.

Special attention is also called to the low price at which the machine is sold, making it possible for those who have use for a fine lathe to secure one without paying the exorbitant price ordinarily demanded for a tool of this kind.

The machine is especially adapted for turning rods and tubing, for reaming, burnishing and spinning, as well as for drilling, trimming, grinding, frazing and buffing work. The machine is supplied in many different combinations. It is supplied mounted on a bench connected with an electric motor, and having the various fittings used in the above mentioned operations. This machine is very substantially built, heavier, in fact, than would appear necessary, all of which adds to the value of the machine and makes it one that will last practically a lifetime. The machine is made in two sizes, one having a 2-foot bed and the other a 3-foot bed. The swing, however, on each machine is the same, 8 inches, but the distance between the centers is 8 and 20 inches, respectively.

The tailstock is fitted with a self-discharging center and the headstock with a three-step cone pulley. The lathes, however, may be fitted with loose and tight pulleys for operating from a main shaft or a single pulley for operating with a motor.

The catalog referred to is especially interesting to those having use for a machine of this kind, and as the price of the machine is much below that ordinarily demanded for a very accurate lathe, it would be to the interest of those interested to secure a copy of the same.

An Extreme Service Test of Improved Granite Block Pavement

Thru the courtesy of the photographer who made the original picture and the Granite Paving Block Manufacturers' Association, we present herewith two views of Astor place, New York, in front of John Wanamaker's store.

The illustration No. 1 shows the improved granite block pavement as it appeared when completed in 1911. The illustration marked No. 2 is a photograph of this pavement taken on January 13, 1915, from practically the same point as photograph No. 1.

This pavement is actually in just as good condition today as the day when it was laid and close examination of the

ASTOR PLACE, *New York, improved granite block pavement as completed in 1911, showing condition at that time.*

blocks shows no perceptible wear even under the tremendous and continuous heavy traffic conditions which prevail at this point.

Fortunately no street opening has been made since this pavement was laid and this gives an ideal opportunity for the engineer and layman to make comparisons concerning the exceptional value of improved granite blocks laid under improved specifications which now prevail in the city of New York.

Another very important feature of this particular section of New York city pavement at this popular corner is the fact that, with all of the traffic, it has cost absolutely nothing for upkeep or maintenance, and, in the opinion of several expert city engineers, this particular pavement without disturbance will stand up to those traffic conditions for from fifteen to twenty years with the expenditure of very little, if any, money for maintenance and upkeep, and it is even possible that the life of this pavement may extend to twenty-five or thirty years with practically little maintenance.

ASTOR PLACE, *New York, improved granite block pavement as it appeared on January 13, 1915, indicating the heavy traffic to which it is subjected. John Wanamaker's great department store is on the left.*

HEAVY FLOOD *and consequent washout produced this condition of the small vitrified pipe culvert which was sufficient for all ordinary conditions.*

A Culvert Hard to Maintain

When the infrequent floods come in California they overstep all bounds and small culverts, sufficient for practically all times, are inadequate while the flood flow continues. Sometimes the overflow causes serious washouts like that shown in one of the accompanying photographs, the friable nature of the soil causing it to crumble rapidly under the action of the rapidly flowing water. The culvert shown in the first view was replaced by that shown in the second, which is of corrugated American ingot iron with concrete protection walls. It is also set lower in the ground, so that the undermining action of the water will not be so serious. Should another flood some time in the future again overflow the road and wash it out, the corrugated iron culvert is expected to keep its shape so that it can be picked up and relaid without requiring new material. This expectation is based on past experience.

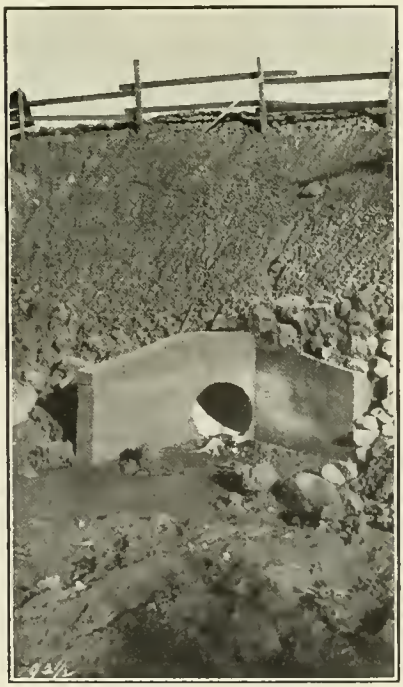
Trade Notes

The Lea-Courtenay Company have opened their own Chicago branch to take care of the increase in their business in turbine and volute pumping machinery. Mr. Maher, formerly of Maher & Byrne Company, agents for the Lea-Courtenay Company, has resigned from the former company to become Chicago manager of the latter.

The Harris patents on electrolytic sewage disposal have been acquired by the John Fuller Engineering Company, 50 Church street, New York, who will give full information regarding the process.

Among the recent contracts awarded the Raymond Concrete Pile Company are 1,579 piles for the foundation of the Schenley High School, Pittsburg, Pa.; foundation for public school No. 5, Jersey City, N. J.; appraisers stores, Milwaukee, Wis.; for the building for the Brett Lithographic Company, Long Island City, N. Y.; for the foundation of power plant for the City Hospital, Cleveland, Ohio; for

CORRUGATED ARMCO INGOT IRON CULVERT *replacing the culvert shown above. If this culvert is washed out it can be picked up and relaid in place. Note concrete head and wing walls protecting the end from wash.*



apartment building on Delaware place and Seneca street, Chicago, Ill.; for standard concrete piles and reinforced concrete footings for the extension to the H. J. Heinz Company warehouse at the Pittsburg plant: for the foundation of the Nurses' Home of the Methodist Episcopal Hospital, Brooklyn, N. Y.

MacArthur Concrete Pile & Foundation Company have been awarded contracts covering concrete pile foundation of the coke bin and coal unloading pocket at the plant of the Philadelphia Suburban Gas & Electric Company, Chester, Pa.; the pile foundation of the Sylvan avenue viaduct, Pittsburg, Pa.; the foundation, including piles and reinforced concrete capping, of the pan house and extension to boiler house at plant of Paterson Parchment Paper Company, Passaic, N. J.; concrete pile foundation of the bridge to be erected over the St. John River between Van Buren, Maine, and St. Leonard, N. B.; concrete piles necessary in connection with the Perry Memorial, Put-in-Bay, Ohio; and the Lynn (Mass.) Gas & Electric Company's new 5,000,000-cubic-foot gas holder.

The Hydraulic Press Brick Company, St. Louis, Mo., is a recent addition to the list of licensees of the Dunn Wire-Cut-Lug Brick Company, Conneaut, Ohio, raising the number to 26 companies, operating 42 plants.

Foreign shipments of motor trucks aggregating in value more than $700,000 have been made by the Kissel Motor Car Company, of Hartford, Wis. Advices received by the company from abroad and from American agents of European governments indicate that even greater business will soon be placed and that Kissel-Kar trucks will be specified in a large portion of it.

The Koehring bar cutter and bar bender are two of the convenient machines for reinforced concrete work supplied by the Koehring Machine Company, Milwaukee, Wis., makers of the famous Koehring line of concrete mixers.

Trade Publications

A circular of Milwaukee mixers is issued by the Milwaukee Concrete Mixer Company, of which A. L. Tucker, Old Colony Building, Chicago, Ill., is the western district manager.

The use of the pulmotor in the New York subway accident is sketched and illustrated in a circular of The Draeger Oxygen Apparatus Company, Pittsburg, Pa.

The Armco Triangle is a periodical circular issued by the American Rolling Mill Company, Middletown, Ohio, and devoted to American Ingot Iron and its products.

The improved Barnard Castle road and pavement scraper is now made by G. H. Atkinson Company, 30 Church street, New York, who will send information about it.

The Red Book of the U. S. Gypsum Company is full of information on gypsum, its products and how to use them. General offices, 205 West Monroe street, Chicago, Ill.

The Twentieth Century pick-up street sweeper is illustrated and described in a circular of the Baker Manufacturing Company, Springfield, Ill.

The Austin-Western Road Machinery Company, Chicago, Ill., has issued a loose-leaf pocket memorandum book which will be very useful to those who have it, and it can be obtained on application if the name of MUNICIPAL ENGINEERING is mentioned in writing for it. In addition to the pages for memoranda it has a catalog of the ten handsomely illustrated catalogs issued by the company, showing what each catalog contains.

The Pneumatic Placing Company, 45 Broadway, New York, issue frequent circulars regarding the pneumatic method of conveying and placing concrete.

The Heltzel hanging system of concrete road forms is fully described and illustrated in a circular of the Heltzel Steel Form and Iron Works, Warren, Ohio.

Structural Conservation is the title of a monthly devoted to integral waterproofing and edited by the general director of the Truss-Con Laboratories, Detroit, Mich.

The frightfulness of fire, the abhorrence of rats, the health of hogs and the advantages of good roads are the striking subjects portrayed in four new posters issued by the Universal Portland Cement Company. The posters are each 19 by 26 inches, and are sent out carefully enclosed in mailing tubes, upon request to the publicity bureau of the company, Chicago.

Various styles and designs of Studebaker dump wagons are illustrated in circular A 894, which will be sent on request of the Studebaker Company, South Bend, Ind., or at any of their branch houses.

The Sandusky Portland Cement Company, Sandusky, Ohio, have issued a new, handsomely illustrated booklet on Medusa white stainless portland cement, which shows the many uses to which it is put and that it is essential to artistic effects and has therefore been used in many of the most important buildings constructed in recent years thruout the country.

The National Bulletin for February, 1910, shows the increase in the use of steel pipe since 1888 from practically nothing to nearly 2¼ million tons.